Arctic Collembola I – Alaskan Collembola of the families Poduridae, Hypogastruridae, Odontellidae, Brachystomellidae and Neanuridae

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The paper provides information on taxonomy, ecology and biogeography of 85 species of Alaskan podurids. A few Siberian species that might be found in Alaska, are included. New records from NE Siberia (Chukotka) are reported. Identification keys to genera and species are given.
The following 20 new species are described: *Hypogastrura (H.) tooliki, H. (Mucrella) denali, H. (Cyclograna) wallmoi, H. (Ceratophysella) isabellae, Xenylla betulae, Willemia granulata, Friesea alaskella, Pratanurida tananensis, P. foxi, Micranurida porcella, M. valiana, Anurida beringi, A. interior, A. martynovae, A. narli, A. reducta, A. similis, A. subarctica, Paranura sitchensis, Neanura (Endonura) tundricola.*
Mucrella, including 1 European, 1 Asiatic and 2 or 3 Nearctic species, is described as a new subgenus of *Hypogastrura*. A new genus, *Christobella*, is erected for *Nenaura ornata* Folsom.
The following new synonyms are established: *Hypogastrura concolor* var. *setosa* Schött, 1923 and *Hypogastrura spitsbergensis* Stach, 1962 = *Achorutes dubius* Tullberg, 1876 which has the valid name *Hypogastrura tullbergi (Schäffer, 1900). Hypogastrura essa* Christiansen & Bellinger, 1980 = *Hypogastrura pannosa* Macnamara, 1922. *Hypogastrura hirsuta* Valpas, 1967 and *Ceratophysella arctica* Martynova et al., 1973 = *Achorutes longispinus* Tullberg, 1876. *Willemia aspinata* Stach, 1949 = *Willemia denisi* Mills, 1932. *Friesea nauroisi* Cassagnau, 1958 = *Friesea quinquespinosa* Wahlgren, 1900. *Anurida frigida* Fjellberg, 1973 = *Micranurida polaris* Hammer, 1954. *Kodiakia prima* Bödvarsson, 1960 and *Kodiakia aleuta* Bödvarsson, 1960 = *Neanura serrata* Folsom, 1916.
Lectotypes of the following species are designated: *Hypogastrura tullbergi* (Schäffer), *Hypogastrura concolor* (Carpenter), *Anurida papillosa* (Axelson) and *Morulina gigantea* (Tullberg).
In addition the type material of the following species have been examined: *Hypogastrura navicularis* (Schött), *H. distincta* (Axelson), *H. essa* Christiansen & Bellinger, *H. macrotuberculata* Hammer, *H. trybomi* (Schött), *H. longispina* (Tullberg), *H. maheuxi* Butler, *Xenylla canadensis* Hammer, *Friesea quinquespinosa* Wahlgren, *Micranurida spirillifera* Hammer, *M. furcifera* Mills, *Anurida decemoculata* Hammer, *A. weberi* Christiansen & Bellinger, *A. papillosoides* Hammer, *A. polaris* (Hammer), *Paranura quadrilobata* Hammer, *Morulina kotzebuensis* Bödvarsson, *Morulodes primus* (Bödvarsson), *M. aleutus* (Bödvarsson).
The status of several Pseudachorutinae genera are discussed *(Pratanurida, Stachorutes, Protachorutes, Micranurida, Anurida)*. The species *endroedii* Dunger and *sensillata* Gisin are transfered from *Anurida* to *Micranurida*.
Apart from generally distributed species, the following distributional patterns were found: Arctic, Hudsonian, Brooks Range/Alaska Range (Alpine) and Pacific coastal. A definite Aleutan element could not be demonstrated.
The Alaskan fauna of the poduride families is dominated by the 32 species of *Hypogastrura* s.l. The *Anurida* complex *(Pratanurida, Micranurida, Anurida)* appears particularly well differentiated in Beringia with 20 species present in Alaska.

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1. Introduction

The scope of the present work is to give a survey of the systematics and distribution of the Collembola in northern parts of the Holarctic region, the area generally called the Arctic. As stressed by Remmert (1980), there is no universally accepted definiton of the Arctic. Danks (1981) applied the

term to the areas north of the tree limit. Other authors include the total area influenced by permafrost which penetrates well into the boreal forests. As my main interest lies in the phylogenetic and biogeographic evolution of the northern Collembola in general, I prefer a broad definition of the Arctic and include the northern tundra and adjoining parts of the boreal forests, which roughly correspond to the permafrost limits shown in Fig. 1.

Recent studies of late Tertiary insect assemblages in Canada and Alaska suggest that the roots of the present tundra fauna are to be sought in the Miocene boreal forests (Hopkins et al. 1971, Matthews 1979). Thus the present northern forest species may show important phylogenetic sister relationships to tundra species.

Compared to the tropics, the Arctic is a fairly small biogeographical unit and is a nearly continuous landmass for 4/5 of its extent. The only major physical barriers to free movement of plants and animals in recent time are the Davis Strait and the North Atlantic, although the water gaps of the Bering Strait and the Canadian archipelago offer substantial barriers to postglacial movements and recolonisations (Behan 1978).

Even during the most severe glacial periods, large portions of the Arctic were ice-free including much of northern Siberia, north and central Alaska with adjoining part of the Yukon , Banks Island and N. Greenland (Peary Land). Ice-free areas probably also existed in the northern part of Ellesmere Island and Baffin Island (Flint 1971, Matthews 1979, Scudder 1979). The Alaska/Yukon was broadly connected to E. Siberia and formed the Beringia refugium, of prime importance to the postglacial recolonisation of northern Nearctic (Hopkins 1967, Danks 1981). This is one of the underlying reasons for starting the analysis of the arctic Collembola in Alaska.

Although some of the early pioneering works on collembole systematics were based on materials collected by various arctic expeditions (Tullberg 1876, Schött 1893, Schäffer 1900), progress in the systematics of arctic Collembola has been slow. As a result, a large portion of the fauna still consists of undescribed or poorly defined species. A regional faunistic analysis based on previously published specied lists, like that made by Behan(1978) on arctic Acari, is thus of limited value.

However, the increased utilisation of the natural resources of the Arctic both in Eurasia and North America, has created a new interest for studies of fundamental biological processes in the tundra and taiga ecosystems. It is realised that a firm knowledge of systematics and taxonomy of arctic arthropods is essential for progress in these fields. Important contributions from Canadian entomologists are paving the way for future students in taxonomy of arctic insects (Danks 1979, 1981). It is hoped that this interest will also extend to the Collembola which is indeed one of the most significant groups of Arctic arthropods.

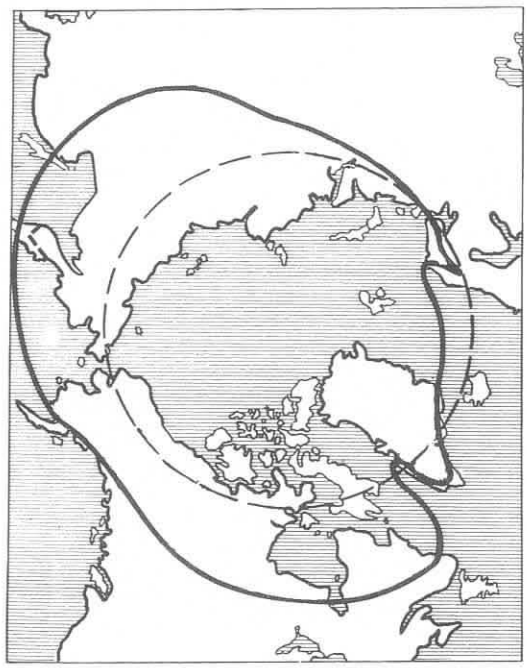


Fig. 1. The Arctic. Southern limit of continuous permafrost (after Remmert 1980).

2. Study area

A description of the physiography and climate of Alaska is beyond the scope of the present work. Papers by Holmquist (1975) and Danks (1979, 1981) may be consulted as to a general review of the area.

There have been many attempts to make a regional subdivision of North America based on either the flora or fauna (Scudder 1979). So far zoologists have mainly used mammals (Allen 1892, Merriam 1892, Hagemeier 1966) or birds (Udvardy 1963). A biotic division, using the combined in-

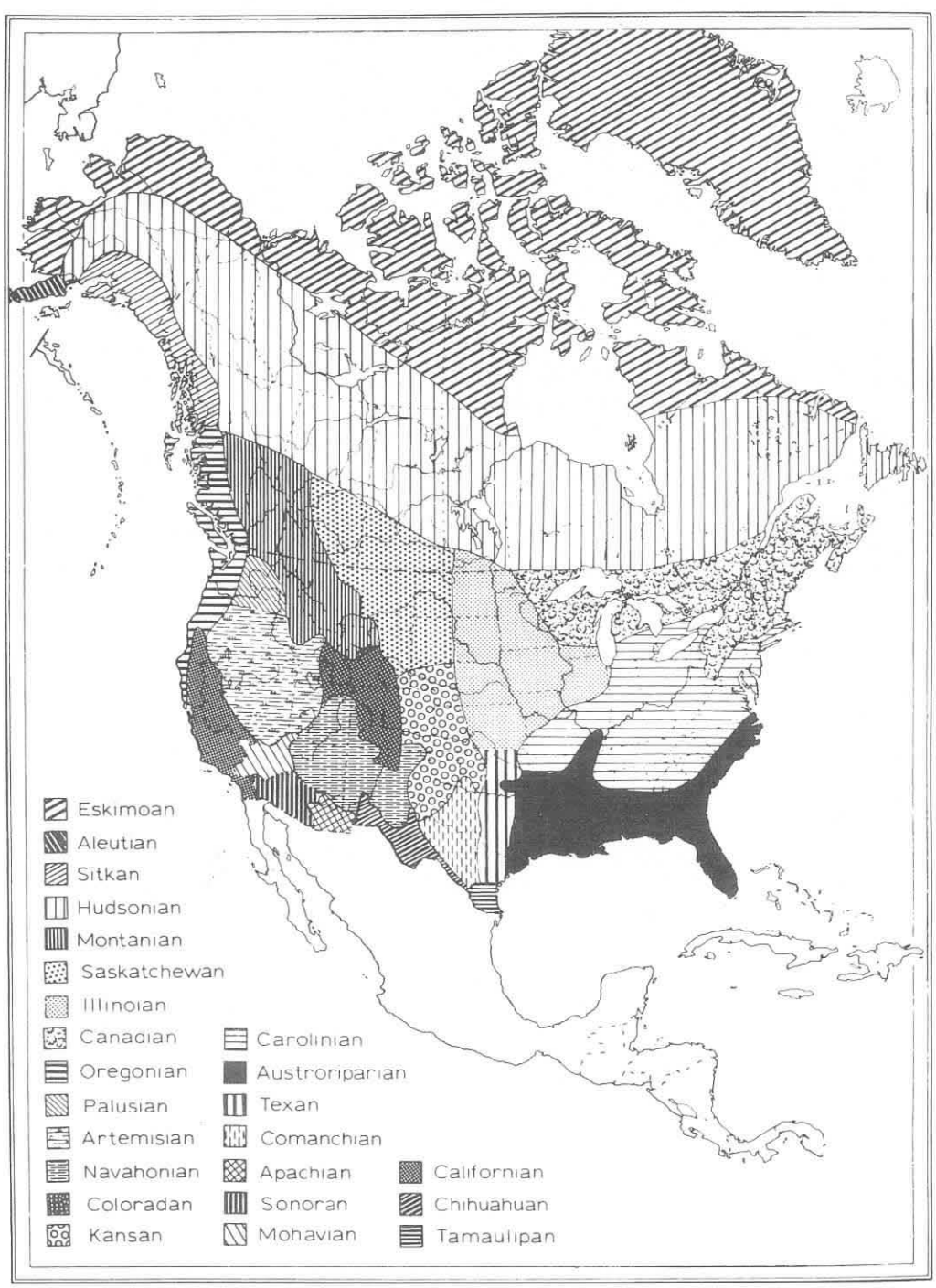


Fig. 2. Biotic provinces of North America (after Scudder 1979, based on Diece 1943).

Fig. 3. Alaskan collecting sites.

formation from both plant and animal distribution, is presented by Diece (1943). According to him, four provinces enter Alaska (Fig. 3):

1. Eskimoan with the northern tundra and the tree-less part of western Alaska along the Bering Sea down to the Alaska Peninsula.
2. Aleutian with the tree-less, cold maritime Aleutian islands and the barren part of Alaska Peninsula.
3. Hudsonian with the boreal forests (coniferous and mixed deciduous) of central Alaska.
4. Sitkan with the lush coniferous forests along the coast from Cook Inlet south to the Canadian border.

Some authors (Mason 1958) exclude the Bering Sea area south of Seward Peninsula from the Eskimoan (Arctic) province and classify it as tree-less Hudsonian.

For a practical grouping of sample sites, the following geographical division of Alaska is used (biotic provice in parenthesis) (Fig. 3):

A. North Slope (Eskimoan). The tundra north of Brooks Range including the arctic coast from the Canadian border to Cape Thompson (Locs. 1–14).

B. Brooks Range (Eskimoan) (Locs. 15–20).

C. Central (Hudsonian). The coniferous and mixed deciduous forests along the Yukon/Kuskokwim river systems between Brooks Range and Alaska Range. Some of the eastern sites are above the tree-line (Locs. 21–30).

D. Alaska Range (Eskimoan) (Locs. 31–38).

E. Bering Area (Eskimoan). Tree-less part of western Alaska from Cape Krusenstern to Alaska Peninsula. Included are also the islands in the Bering Sea except the Aleutians (Locs. 39–48).

F. Aleutian Chain (Aleutian) including the Alaska Peninsula (Locs. 49–54).

G. SE Coast (Sitkan). Coastal forests from the Alaska Peninsula to Canadian Border. Coastal mountains at Juneau are included (Locs. 55–57).

3. Material

The material, on which this and following papers are based, was collected by a large number of persons from all principal parts of Alaska. Usually soil samples of various size, including vegetation, litter and upper soil layers, have been brought back to the laboratory and extracted in simple Tullgren funnels heated by light bulbs. The major part was collected by myself during the summers 1976 and 1980, operating from Fairbanks. The construction of the haul road along the Prudhoe Bay–Valdez pipeline offered a unique possibility for intense collecting along a principal transect of Alaskan biota. In the period 13–21 August 1976 a team consisting of S. F. Maclean (Psylloidea, Enchytraeidae, etc.), V. Behan (Acari) and myself (Collembola) made a survey from Yukon Bridge to Prudhoe Bay with the following stations (mileage from Yukon Bridge): Yukon River 0 mi, unnamed creek 22–23 mi, Kanuti River and Finger Mts. at Old Man Camp ca. 50 mi, Gobbler Knob S of Prospect Camp ca. 80 mi, Sukakpak Mt. S of Dietrich Camp 147 mi, "Last Spruce" S of Chandalar Camp 178–179 mi, Atigun Pass 190 mi, high mts. W of Atigun Camp 195 mi, mts. across (E of) Galbraith Lake Camp ca. 216 mi, Atigun River 217 mi, Toolik Lake 230 mi, E of Toolik Camp 233 mi, Happy Valley Cut 271 mi, Sagavanirktok River ca. 290 mi, Sagwon Upland ca. 295 mi, Great Pingon N of Franklin Bluffs Camp 315 mi, Sagavanirktok River N of Franklin Bluffs Camp 318 mi, Prudhoe Bay 360 mi.

Other major excursions made by myself are : 31 July–2 August 1976 and 26–27 July 1980 to Twelve Mile Mt., Eagle Summit, Eagle Creek and Mastodon Dome at Steese Hwy. NE of Fairbanks, 25–29 August 1976: Atkasuk at Meade River S of Barrow, 29–30 August 1976: Barrow, 12–17 July 1980: Juneau, collecting along Montana Creek Trail up to muskeg at water divide, then in mountains above "Miners Cabin", 29–31 July 1980: Along Denli Hwy. from Cantwell to Paxson and various places along Richardson Hwy. from Paxson to Delta, 9 August 1980: Mountain ridges up to Triangle Peak between Castner Glacier and Canwell Glacier on Richardson Hwy. N of Paxson.

Apart from this, numerous excursions were made to the near surroundings of Fairbanks (Chena Ridge, Bonanza Creek Experimental Forest, Washington Creek Forest Site etc.). In addition many students and staff members of the Institute of Arctic Biology, Fairbanks , brought back soil samples from various places scattered throughout Alaska. Fig. 3 shows localities from which smaller or larger collections were obtained.

As a result of a US–USSR scientific exchange program, S. F. MacLean visited Chukotka in 1975 and 1977 and examined soil fauna near Magadan, at Aborigen in the Kolyma mountains and at Chaun Bay on the Arctic coast. In 1979 MacLean, P. J. Webber, V. Behan and myself joined forces and made extensive collections in the same area. The material is only partly worked (MacLean et al. 1978) and will be the source for future publications. In the present paper I refer to Siberian records of Alaskan species as far as they are identified.

In August 1980 a short visit was made to Mt. Rainier and the Wenatchee Mts. in Washington in order to trace the distribution of northern forms further down the Cordillera. Brief references to this material are given in the following sections. In August/September 1980 more extensive collections were made in alpine sites in the Colorado Front Range near Boulder. The material is published elsewhere (Fjellberg 1984a), but some references are also given in the present paper.

4. Systematic part

The following section provides keys to and descriptions of species with notes on their distribution and ecology. For a general description of collembolan anatomy and identification technique, the monograph of Christiansen & Bellinger (1980) may be consulted.

The following abbreviations of morphological terms are used:

Abd.: Abdomen
Ant.: Antenna
Ant. Org.: Antennal organ
Lam.: Lamella
Max. o.l.: Maxillary outer lobe
PAO: Post antennal organ
T.: Tibiotarsus
Th.: Thorax

The specimens are preserved in 75% ethanol or mounted in sealed cavity slides with the Gisin (1960) medium.

Type material is deposited in the following institutions:

USNM U. S. National Museum of Natural History, Washington.

MCZ Museum of Comparative Zoology, Harvard Univ., Cambridge Massachusetts.
BM British Museum (Nat. Hist.), Dept. of Entomology, London.
AF My own collection, presently at Tromsø Museum, Norway.

Key to Alaskan genera of families Poduridae, Hypogastruridae Odontellidae, Brachystomellidae and Neanuridae

1. Furca very prominent, with slender, curved dentes which are distally ringed (Fig. 4) (Poduridae) ..... *Podura* p. 10
– Furca less prominent, sometimes absent. Dentes shorter, thicker, without distal rings 2
2. Mandibles complete, with distinct molar plate (Hypogastruridae) 3
– Mandibles more or less reduced, molar plate absent 8
3. PAO absent ..... *Xenylla* p. 56
– PAO present 4
4. Furca absent ..... *Willemia* p. 60
– Furca present 5
5. Eyes 8+8 ..... *Hypogastrura* p. 12
– Eyes 6+6 or less 6
6. Mandibles weak, with small molar plate. Maxillary outer lobe without sublobal hair (Figs. 180, 183). Th. 2–3 without seta p_3. Setae of m–row absent on Th. 2–Abd. 4 (Fig. 181) ..... *Microgastrura* p. 56
– Mandibles normal with strong molar plate. Maxillary outer lobe with 1–2 sublobal hairs. Th. 2–3 with p_3 present. m–setae present on Th. 2– Abd. 4 (Figs. 176, 177) 7
7. Eyes 6+6. Maxillary outer lobe with one sublobal hair (cf. Fig. 139). Abd. 4 with $p_1 < p_2$ (Fig. 176) ..... *Schaefferia* p. 54
– Eyes 1–3 on each side. Maxillary outer lobe with 2 sublobal hairs (cf. Fig. 55). Abd.4 with $p_1 > p_2$ (Fig. 177) ..... *Bonetogastrura* p. 54
8. Mucro either trilamellate (Fig. 228) or hooked (Fig. 232). In last case PAO triradiate (Fig. 235) (Odontellidae) 9
– Mucro different, often absent. PAO never triradiate 10
9. Mucro trilamellate (Fig. 228) ..... *Odontella* p. 66
– Mucro hooked (Fig. 232) ..... *Xenyllodes* p. 66
10. Maxilla short, with many small, strong teeth. Lamellae absent (Fig. 237) (Brachystomellidae) ..... *Brachystomella* p. 68
– Maxilla more slender, normally with both teeth and lamellae (Figs. 253, 277, 313) (Neanuridae) 11
11. Maxilla sickle-shaped (Fig. 253). Abd. 6 with 3 or more anal spines (Fig. 241) ..... *Friesea* p. 68
– Maxilla different. Anal spines absent 12
12. Furca fully developed with distinct mucro (Figs. 268, 273) ..... *Pseudachorutes* p. 71
– Furca absent or reduced, mucro absent (Fig. 281) 13
13. Either body tuberculate with clearly bilobed Abd. 6 (Fig. 405) or PAO absent 16
– Body smooth, at most with slightly enlarged granular fields (Fig. 294). Abd. 6 normally rounded or square (Figs. 341, 355). PAO present 14
14. Eyes 8+8. Th. 2 with seta a_2 present (Fig. 274). Tenent hairs clavate (Figs. 282, 283) ..... *Pratanurida* p. 76
– Eyes normally reduced. Th. 2 without a_2 (Fig. 287). Tenent hairs acuminate 15
15. Maxilla prolonged, styliform, with unclear lamellae (Fig. 288) ..... *Micranurida* p. 80
– Maxilla shorter, lamellae usually distinct ..... *Anurida* p. 86
16. PAO present, multituberculate (Fig. 404). Large, dark ..... *Morulina* p. 110
– PAO absent, smaller, often pale species 17
17. Body smooth, without tubercles. Abd. 6 rounded or square, not cleary bilobed (Fig. 381) ..... *Paranura* p. 106
– Body tuberculate, Abd. 6 bilobed (Fig. 410) ... 18
18. Maxilla with a very long, multiciliate lamella (Fig. 407) ..... *Morulodes* p. 114
– Maxillary lamellae shorter, at most with a few serrations (Fig. 413) 19
19. Body tubercles as Fig. 414. The clypeal (Cl), antennofrontal (AF) and ocular (Oc) tubercles on head fused, like the dorsolateral (Dl), lateral (L) and subocular (So). On Abd. 4 dorsointernal (Di) pair fused as are the dorsoexternal (De) and dorsolateral (Dl) on each side. Abd. 5 with all tubercles fused to a single plate ..... *Christobella* p. 116
– Body tubercles as Figs. 417, 418. All Cl, AF and Oc on head separate. All Abd. 4 tubercles separate. On Abd. 5 only the median pair fused 20
20. Di and De tubercles on head separate (Fig. 418) ..... *Neanura* subg. *Endonura* p. 120
– Di and De on head fused (Fig. 417) ..... *Neanura* subg. *Deutonura* p. 117

4.1 Family Poduridae

4.1.1 Genus *Podura* Linnaeus, 1758

Type species: *Podura aquatica* Linneaus, 1758

Podura aquatica Linnaeus

Fig. 4

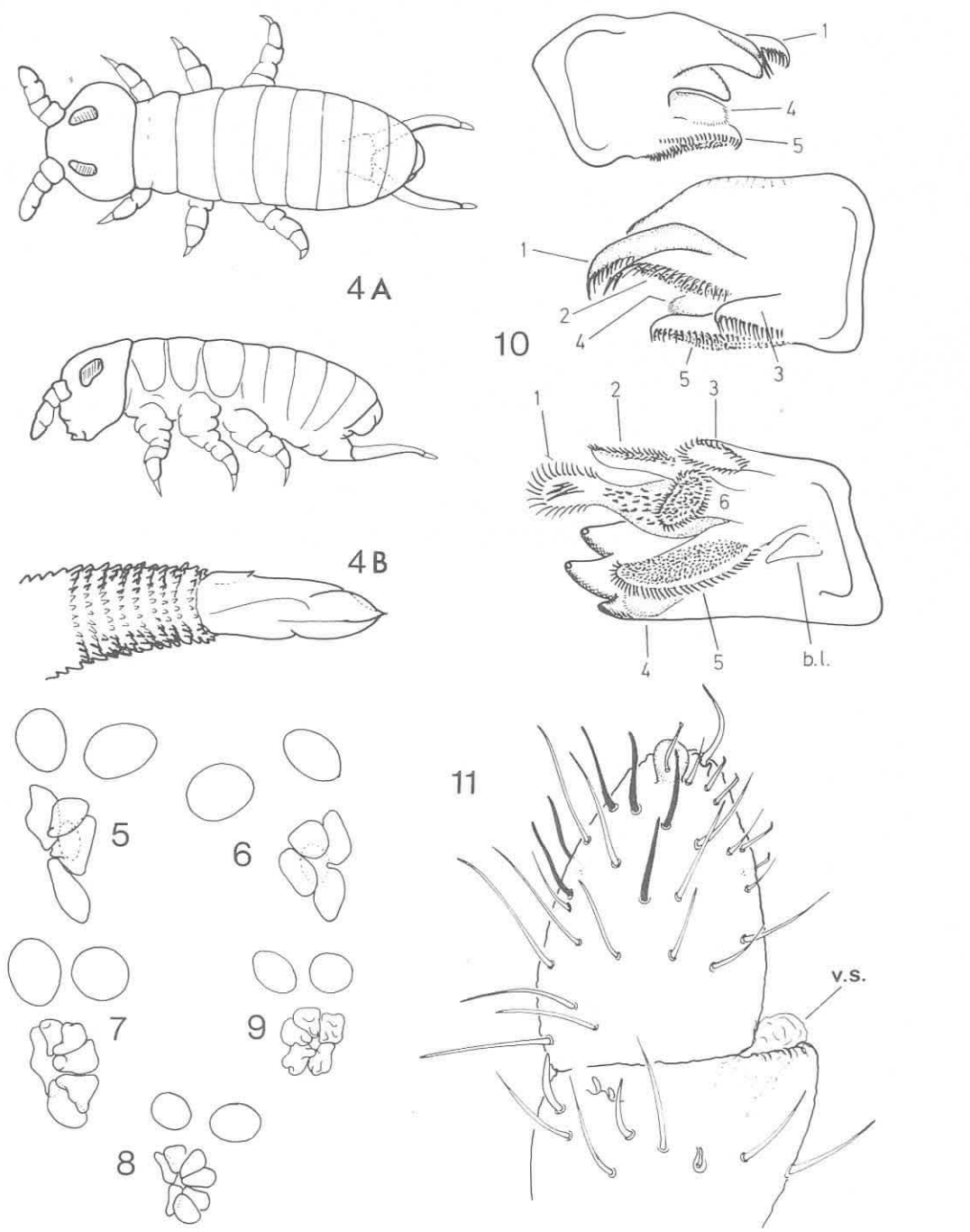
Podura aquatica Linnaeus, 1758:609

Description

Colour variable from reddish-brown to brownish-black, dorsal side darkest.

Size 1.3 mm.

Maxillary outer lobe with one sublobal hair. Th.1 – Abd.3 with a single transverse row of short, undifferentiated setae. dens long, curved, with only dorsal setae. Apical 1/4 distinctly ringed (Fig. 4b).



Figs. 4–11. — 4. *Podura aquatica*. – A. Habitus. – B. Tip of dens with mucro. — 5–11. *Hypogastrura denali* n.sp. — 5. Left PAO of clavate form from Alaska Range. — 6. Right PAO of same specimen. — 7. Left PAO of specimen from Brooks Range. — 8. Left PAO of another specimen from the same sample. — 9. Right PAO of specimen from Cape Thompson. — 10. Maxilla. Dorsal, ventral and inner sides. — 11. Right Ant.3–4 of Cape Thompson specimen. – v.s.: Ventral sac.

Discussion

The species is immediately identified by its extraordinary strong furca and the simple chaetotaxy.

Distribution and ecology

A characteristic species in wet habitats with some open water. Probably distributed all over Alaska. *North Slope* (Canning River delta, Prudhoe Bay, Colville River delta, Barrow, Meade River, Toolik Lake), *Bering Area* (Nunivak Isl.), *Central* (Eagle Summit), *Alaska Range* (Denali Hwy. E of Clearwater Mts., Watana Mt. in Talkeetna Mts.). – *Total distribution:* Holarctic.

4.2 Family Hypogastruridae

4.2.1 Genus *Hypogastrura* Bourlet, 1839

Type species: *Achorutes viaticus* Tullberg, 1872

This large genus is split into a number of subgenera which are not at all sharply delimited from each other. In particular the *armata* group of the subgenus *Ceratophysella* is rather poorly set off from the subgenus *Hypogastrura* s. str. Bourgeois & Cassagnau (1972) have given a good survey of the situation. Detailed studies of chaetotaxy and maxillary structures make it possible to rearrange some of the groups and sharpen the limits between the subgenera (Fjellberg 1984b). The following key may be used for separation of the Nearctic and European subgenera:

1. Maxilla with lam. 4 reduced to a smooth, marginally ciliate flap hidden by lam. 5 (Fig. 10) .... *Mucrella* n.subg. p. 12
– Maxillary lam. 4 strong, densely packed with minute denticles, reaching well beyond tip of lam. 5 (Fig. 56) 2
2. Eversible ventral sac present between Ant. 3–4. Macro/microchaetae well differentiated. Anal spines moderate to strong. Apex of mucro broad, spoon-like. Lateral lamella strongly angular (Fig. 138). Maxillary outer lobe with 1 or 2 sublobal hairs (Figs. 55, 139) 3
– Ant. 3–4 without eversible sac. Body hairs uniform, rarely differentiated in macro/microchaetae. Anal spines usually small. Apex of mucro variable, but never spoon-like, dilated. Maxillary outer lobe with 2 sublobal hairs .... *Hypogastrura* s. str. p. 17
3. Th. 2 with seta m_2 present. Abd. 4 with p_1 shorter than p_2. Maxillary outer lobe with 2 sublobal hairs ..... *Cyclograna* p. 48
– Th. 2 with m_2 absent, or if present *(bengtssoni)*, then Abd. 4 with p_1 longer than p_2 (Fig. 128) 4
4. Abd. 4 with p_1 shorter than p_2. Max.o.l. with 1 sublobal hair. If a_2 and a_3 on Th. 2 are different, then a_3 longest .... *Ceratophysella* type A (*denticulata* group p. 41)
– Abd. 4 with p_1 longer than p_2. Max.o.l with 2 sublobal hairs (though see note on *armata* on p. 35). If a_2 and a_3 on Th. 2 different, then a_2 longest .... *Ceratophysella* type B (*armata* group p. 35)

Subgenus *Mucrella* n.subg.

Types species: *Hypogastrura denali* n.sp.

Description

Body shape typical of the genus.

Antennae with a large, eversible sac between segments 3–4. Sensillae and Ant.3 organ normal. Ventral file of Ant.4 more or less developed.

Head with 8+8 ocelli. PAO with 4–7 lobes. Max.o.l. with 2 sublobal hairs. Mandibles with well developed molar plate. Maxillae with 3 teeth and 6 lamellae. Lam.1 with long marginal cilia around apex, denticles only in basal part. One or more subapical spines may be present. Lam.2, 3, 5 and 6 well developed. Lam.4 reduced to a small flap with short marginal cilia only, partly hidden by lam.5.

Body hairs variable from short and uniform to strongly differentiated in macro/microchaetae. Macrochaetae acuminate or truncate/clavate. In species with differentiated macrochaetae, chaetotaxy of Abd.4 is of the B type with p_1 longer than p_2. Th.1 with 2+2 setae. Body granulation variable. Anal spines variable from minute without basal papillae to moderate on large basal papillae. Tibiotarsi with acuminate tenent hairs. Claws with lamellate unguiculus. Ventral tube with 4+4 seatae. Tenaculum with 4+4 barbs. Dens with 7 dorsal setae. Mucro strong with angular lateral lamella. Apex narrow, curved.

Discussion

The unique maxilla of the species in this subgenus are not seen in any other *Hypogastrura* s.l. so far. In some respects *Mucrella* takes an intermediary position between *Hypogastrura* s.str. and the *armata* group of *Ceratophysella*. The Ant.3–4 sac points to *Ceratophysella*, the short body hairs and anal spines (in most species) as well as two sublobal hairs, point to *Hypogastrura*. Also the

shape of the mucro is more like *Hypogastrura* than *Ceratophysella*.

Distribution

Distribution of *Mucrella* is Holarctic, with 1 species in Alaska (*denali* n.sp.), 1 in N. Siberia (*navicularis* Schött) and 1 in the Pyrenees (*acuminata* Cassagnau). In addition, I have seen a few specimens of an undescribed species from Indiana, and there is possibly also one more species present in Alaska.

1. **Hypogastrura (Mucrella) denali** n.sp.

Figs. 5–19, 21–23.

Type locality: Alaska. Alaska Range. Clearwater Mts. E of Susitna Lodge. Summit between Denali Hwy. and Windy Creek.

Type material: Holotype: One specimen (alc.) from "Alaska. Alaska Range . Clearwater Mts. E of Susitna Lodge. 30.VII.1980. Moss, rocks in talus, 5.000 ft. A.Fjellberg leg.", in USNM. – *Paratypes:* 15 (10 alc., 5 slide) as above, at USNM. 20 (alc.) as above, at BM. About 250 (alc.) as above except "Moss at snow edge, 6.000 ft.", at USNM. 6 (slides) as above, at AF. 2 (slide) as above except "Owl mound, thick grass, 5.800 ft.", in USNM. 3 (slide) from "Alaska. Alaska Range. Denali Hwy. 120 mi from paxon, mts. S of road. 29.VII.1980. Moss, lichens, exposed ridge, 5.000 ft. A. Fjellberg leg.", in USNM. 3 (slide) as above except: "Moss & grass, stony slope, 4.800 ft.", at USNM. 3 (slide) from "Alaska. Alaska Range. Triangle Peak between Castner Gl. and Canwell Gl. 9.VII.1980. Moss on gravel near snow, 6.300 ft. A.Fjellberg leg.", at USNM. 6 (slide) as above except. "Moss & Carex, melt water, 5.500 ft.", at USNM. About 150 (alc.) and 19 (slides) from "Alaska . Brooks Range W of Atigun Camp, 19.VIII.1976. Dry moss & lichens on stone, 5.800 ft. A.Fjellberg leg.", at USNM. 10 (alc.) as above, at MCZ. 4 (slide) as above, at AF. 19 (15 alc., 4 slide) from "Alaska. Meade River, Atkasuk, 28.VIII.1976. Old reindeer carcass. A.Fjellberg leg.", at USNM. 7 (slide) as above, at AF. 21 (13 alc., 8 slides) from "Alaska. Cape Thompson, Ogotoruk Creek Basin, 7–11.VIII.1980. Tussock tundra, moss. D. & B.Murray leg.", at USNM. 7 (3 alc., 4 slides) from "Alaska. Canning River delta, 23.VII.1980. Moss, swale in tundra. S.F MacLean leg.", at USNM. 1 (alc.) as above except "Carex pond", at USNM. 1 (slide) from "Alaska. Meade River, Atkasuk, 25.VIII.1976. Wet moss in Salix thicket at shore of small lake. A.Fjellberg leg.", at USNM. 1 (slide) from "Alaska. Great Pingo ca. 10 mi NW Franklin Bluffs, Sagavanirktok River. 17.-VIII.1976. Moist polygon soil. A.Fjellberg leg.", at USNM. 1 (slide) from "Alaska. Icy Cape, 28.VIII.1976. Wet moss, Carex etc. in polygon trough. P. Connors leg.", at USNM.

Derivation of the name: Denali is the Indian name of Mt. McKinley, meaning "The Great".

Description

Colour dark brownish-black.

Size 1.7 mm.

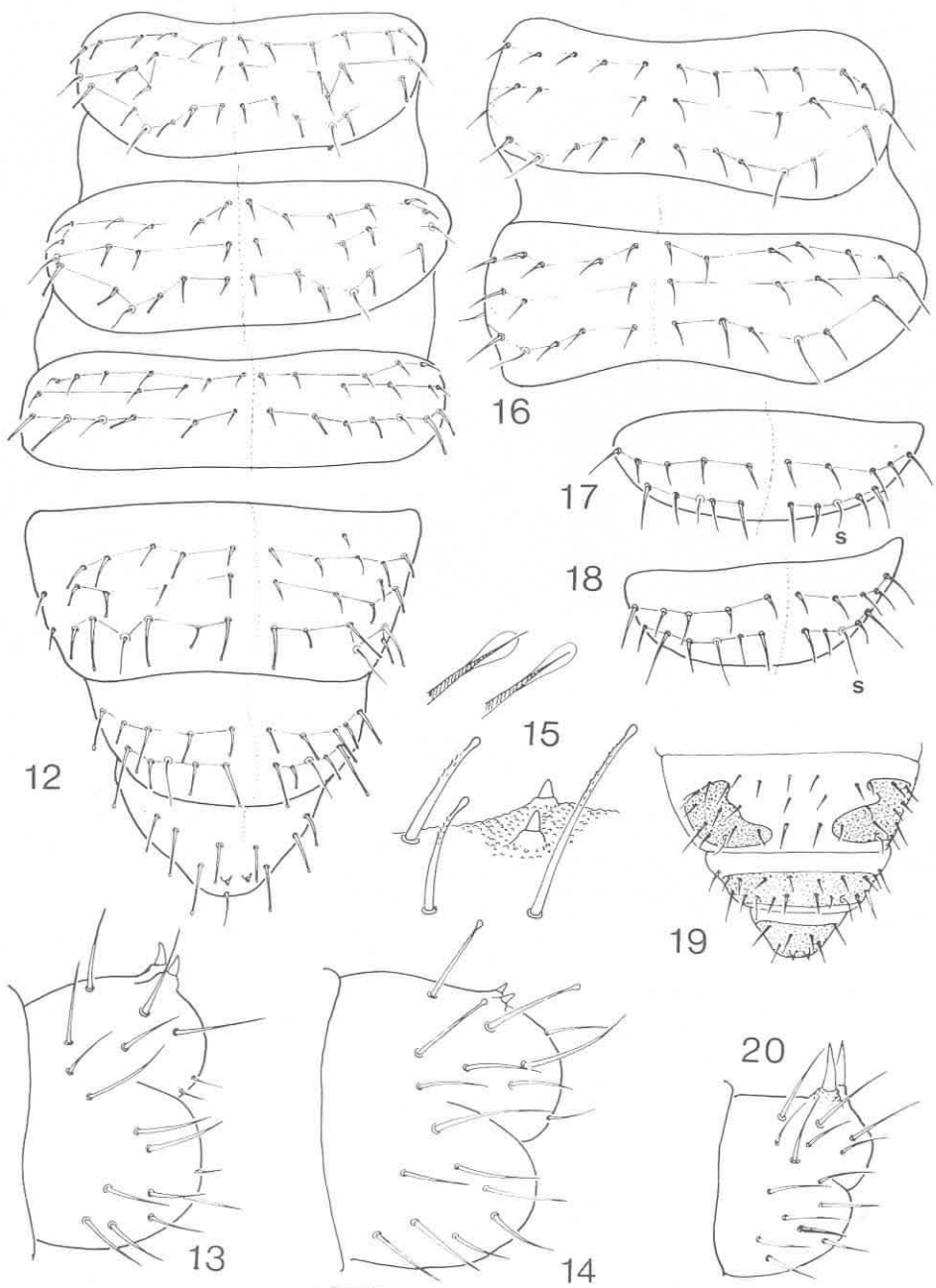
Head. Ant.4 with 6–7 curved sensorial setae which are poorly differentiated from ordinary setae. Apical bulb simple or weakly 3-lobed. Antennal file with 10–15 slightly modified setae. Ant.1 with 7 setae. Labrum with 5–5–4 curved setae. Labral edge with 4 weak lobes. Maxilla as Fig. 10, lam.1 reaching slightly beyond apex of teeth. PAO in a deep groove, with 4–7 irregular lobes which are often closely packed (Fig. 5–9).

Body granulation fine with coarser fields on Abd.4–6 (Fig. 19). Also Th.2 with fields of enlarged granules on each side. Central part of head somewhat coarser than rest. Individual variation in granular strength is frequent. Body hairs short, distinctly ciliate/serrate, macrochaetae poorly differentiated. Chaetotaxy as Fig. 12, variations frequent. Head with 2+2 vertical setae. Th.2–3 with p_2 in backward position. Th.2 with m_2 rarely present. Abd.1–3 with p_1 shorter than p_2, on Abd.4 p_1 slightly longer than p_2. Abd.5 with 2+2 p-setae between sensillae, m_1 absent. Anal spines subterminal, short, slightly hooked. Basal papillae small (Figs. 13, 14). Unguis with distinct teeth: 1 middle of inner edge, 2 on lateral edges (basal, subapical). Unguiculus broadly lamellate, reaching middle of inner unguis. Dens 2.0–2.5 as long as mucro, with 7 dorsal setae and fine uniform granulation. Mucro with a distinct angular lateral lamella (Figs.21–23). Apex in dorsal view narrow, incurved.

Discussion

The above description is based on various Alaska Range populations. Included in the paratype material are a number of samples from other populations displaying a wide morphological variation:

a. Specimens from high alpine snow edge communities (6,000–6,300 ft) in the Alaska Range differ from the main form by having truncate/clavate setae on the last abdominal segments (Fig. 15), very small anal spines, finer and less differentiated granulation on Abd.4–6, a stronger and more sharply set off lateral lamellae on mucro, PAO with more regular and less packed lobes (Figs. 5, 6). At first this form was thouhgt to be a different species. But, considering the distribution and the discovery of ecomorphosis in a Brooks Range po-



Figs. 12–20. — Figs. 12–19. *Hypogastrura denali* n.sp. — 12. Chaetotaxy of Th.2–Abd.1 and Abd.4–6 of clavate form from Alaska Range. — 13. Abd.6. of normal Alaska Range form. — 14. Abd.6 of clavate Alaska Range form. — 15. Anal spines and clavate setae (with details) of Alaska Range specimen. — 16. Chaetotaxy of Th.2–3 of normal (nonclavate) Alaska Range from. — 17. Chaetotaxy of Abd.5 of ecomorphic specimen from Brooks Range. Note short sensilla (s). — 18. Abd.5 of normal specimen, same sample. Note long sensilla (s). — 19. Fields with enlarge granules on Abd.4–6 in Alaska Range specimen. — 20. *Hypogastrura acuminata*. Abd.6 of specimen from the Pyrenees (Oredon, France).

pulation, it does not seem advisable to split the material on characters which are known to be influenced by external conditions (Cassagnau 1972). The modifications seen in the clavate form may be a response to the frigid high alpine snow edge environment. The main form was generally found in wet habitats at lower altitudes. In one case a mixed population was found at an intermediary elevation (5,000 ft). Although there is no evidence at present, the clavate form could be the winter morph of a cyclomorphic species. In extreme habitats the summer form perhaps never appears, or is present for a brief period only. Such indications were found in *Hypogastrura tooloiki* n.sp. (p. 32). Well known cyclomorphic species like *H. nivicola* (Fitch) and *H. socialis* (Uzel) show modification in cuticular structure, mucro shape, etc. (Christiansen & Bellinger 1980, Leinaas 1981a). In the palaearctic species *H.lapponica* (Axelson) the winter morph (*frigida* (Axelson)) has reduced anal spines and less clavate macrochaetae than the summer form (Leinaas 1981b). More field work and/or laboratory studies are necessary to settle the status of the clavate *denali* form.

b. In Brooks Range the species was collected twice from rather dry habitats at about 5,800 ft. Maximum size in these samples is only 1.3 mm and body hairs are finer, shorter and less ciliate/serrate than in the main form from Alaska Range. Also the body granulation is finer with less marked coarser fields on Abd.4–6. Some specimens are clearly ecomorphic with small weak mandibles and maxillae. Mucro is reduced with less marked lateral lamella, granules on Abd.4–5 are enlarged and the p_3 sensillae on Abd.5 are shortened (Fig. 17). The dry exposed conditions of the Brooks Range habitats may be responsible for the appearance of ecomorphic individuals.

c. A number of samples from the North Slope all have very small individuals (max 1.1 mm) with smooth, very short and little differentiated body hairs. Dorsal granulation is fine, uniform. The maxillary lamellae 1 & 2 appear slightly longer than in the main form. On Th.2 the seta m_2 is frequently present. This form, present in the northern tundra from Canning River Delta to Cape Thompson, appears morphologiacally constant and may eventually turn out to be a distinct species.

Concerning the distribution of the 3 forms described above, the various populations appear to form discrete steps in a north-south morphological cline (body size, hair cover, granulation). In view of the high age of the biota in this area, the formation of distinct subspecies in Alaska Range, Brooks Range and North Slope seems quite possible. However, much more field work is necessary to unfold the true nature of these forms.

Distribution and ecology

Alaska Range, Brooks Range and North Slope (for details, see type material above). The species appears to be an arctic/alpine form as there are no records from the central taiga. The habitats span from damp, cold snow edge communities to dry meadows and moss and lichens on exposed rocks and ridges. – *Total distribution*: Alaska.

2. **Hypogastrura (Mucrella) navicularis** (Schött)

Figs. 25–30.

Achorutes navicularis Schött, 1893:83.

Type-material:4 syntypes labelled "Achorutes navicularis Schött n. sp. Jenisej-exped. 1876. Tolstoinos" were found in Naturhistoriska Riksmuseet, Stockholm. One of the specimens is a *Hypogastrura viatica*, the 3 others are *navicularis*. The following description is based on 2 specimens which were cleared and mounted. The type locality, Tolstonosowskoj, is at the Jenisej River, 70°10'N.

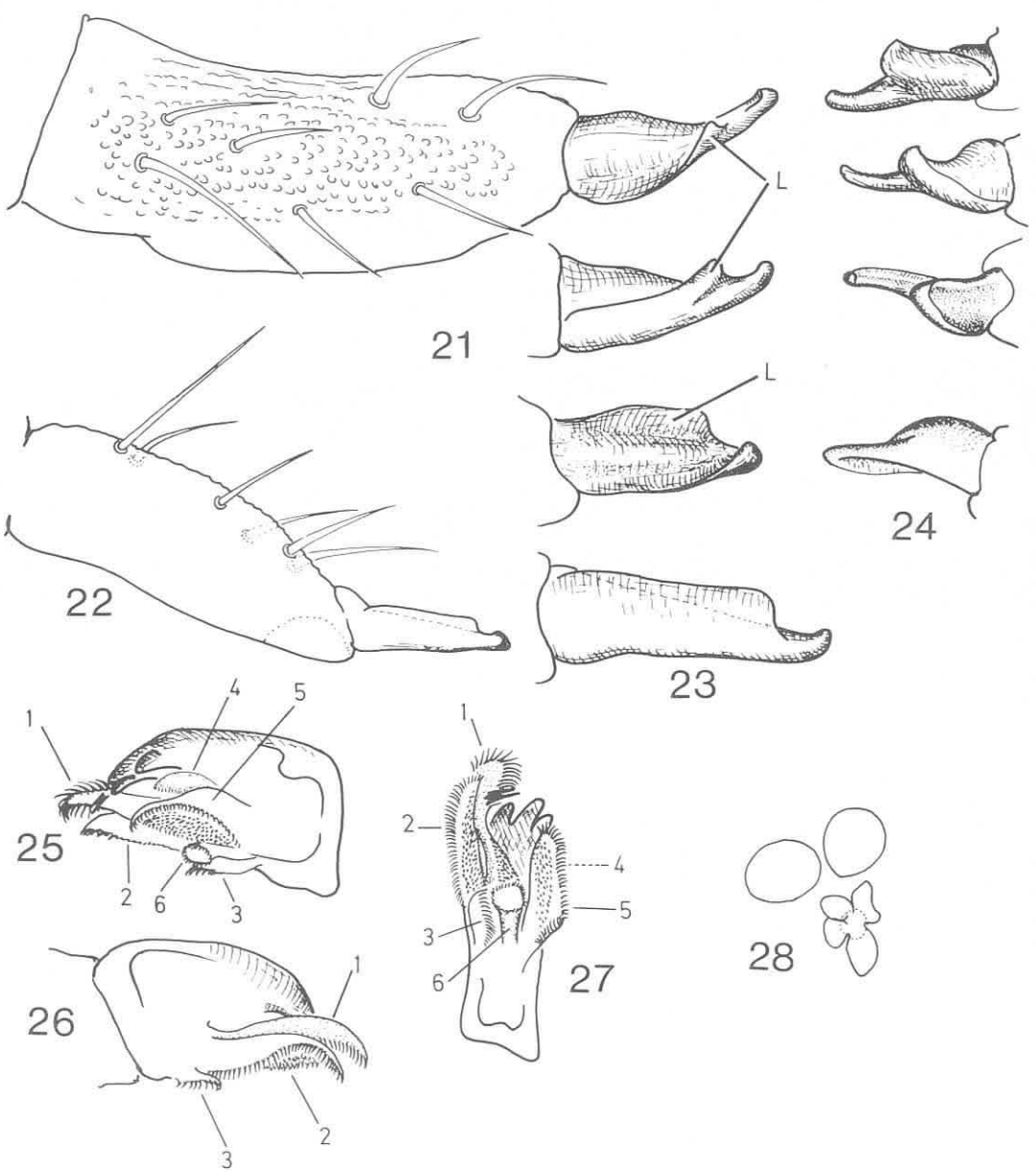
Description

Colour brown or bluish-gray.

Size 1.0 mm.

Head. Ant.3–4 fused dorsally with prominent ventral sac. Sensillae on Ant.4 long, hair-like. Ventral file poorly developed. Ant. 3 organ normal. Labrum with 5–5–4 undifferentiated setae. Max.o.l. with 2 sublobal hairs. Maxilla as Figs. 25–27. Lam.1 longer than capitulum, with long marginal cilia in apical part.Basal part with many fine denticles. Subapical spines present. Lam.4 reduced, hidden behind lam.5. Lam.6 with short marginal cilia only, no denticles in central part. Head with 8+8 ocelli. PAO about as large as an eye, with 4 lobes (Fig. 28)

Body. Chaetotaxy as Fig. 29. Macro/microchaetae strongly differentiated. Macrochaetae acuminate, distinctly serrate/ciliate. Th.1 with 2+2 setae. Abd.4 with $p_1 > p_2$. Body granulation fine, uniform, not enlarged on last abdominal segments. Anal spines small, about 1/5–1/4 as long as inner edge of claw 3 (Fig. 30). Ventral tube with 4+4 setae.



Figs. 21–28. — 21–23. *Hypogastrura denali* n.sp. — 21. Dens and mucro (dorsal, lateral, oblique dorsal) of clavate Alaska Range form. L: Lateral lamella. — 22. Dens & mucro from Cape Thompson specimen. — 23. Mucro (lateral) of nonclavate Alaska Range form. — 24. *Hypogastrura acuminata*. Mucro (lateral, dorsolateral, dorsal, ventral). Specimen from Oredon, France. – 25–28. *Hypogastrura navicularis*. — 25. Maxilla, dorsal. — 26. Ditto, ventral. — 27. Ditto, inner side. — 28. Right PAO.

Tenaculum with 4+4 barbs. Tibiotarsal tenent hairs long, weakly clavate (Fig. 33). Unguis with 2 pairs of lateral teeth and 1 strong inner tooth. Unguiculus broadly lamellate, reaching middle of unguis or slightly beyond. Furca strong. Dens with 7 dorsal setae, inner 2 apical setae expanded and

serrate at base (Fig. 31). Mucro about 1/2 as long as dens. Apex blunt, in dorsal view narrow, incurved (Fig. 32). Lateral lamella distinct, angular. A prominent swelling was seen on inner side at base.

Discussion

The species is clearly a member of the subgenus *Mucrella*, having the typical maxilla, mucro and short anal spines. It differs from the Alaskan *denali* by the strongly developed macrochaetae and the simple maxillary lam.6. The European *acuminata* differs from *denali* and *navicularis* by the mucro which has a very strong, tooth-like lateral lamella and a fine, narrow lamella running along the inner edge (Fig. 24). Also Ant.4 has a well developed ventral file, the anal spines are longer (Fig. 20) and Abd.4–6 have strongly enlarged granules. Maxilla has only marginal cilia on lam.2 and lam.6 has only 3–4 coarse hook-like denticles along anterior margin.

Distribution and ecology

So far only known from the type locality at Jenisej. Habitat is unknown, except that it is arctic tundra. The species will probably be found further east in Siberia, possibly also in Alaska.

Subgenus *Hypogastrura* Bourlet, 1839

Type species: *Achorutes viaticus* Tullberg, 1872.

Key

1. Tenaculum with 3+3 teeth. More than 1 clavate tibiotarsal tenent hair (Fig. 54) 2
– Tenaculum with 4+4 teeth. Clavate tenent hairs 1 or none 7
2. Ant.3 organ with 1 or more additional spines (Figs. 34–36,44) 3
– Ant.3 organ normal (Fig. 57) 4
3. Mucro broad, with large lateral lamella (Figs. 41–43). Median tenent hair longer than others (Fig. 38). Dens with 7–9 setae ..... 3. *sensilis*
– Mucro narrow, lateral lamella small (Figs. 48–52). Tenent hairs equal (Fig. 54). Dens with 5–6 setae ..... 4. *tullbergi*
4. Unguiculus only about 1/3 of unguis inner edge (Fig. 67). Colour green or yellowish-green ..... 8. *perplexa*
– Unguiculus at least 1/2 of unguis. Darker species 5
5. Abd.5–6 macrochaetae strongly differentiated, clavate (Fig. 64). Tenent hairs 3–3–4 .. 7. *distincta*
– Macrochaetae simple, shorter. Tenent hairs 2–3–3 6
6. Large, grayish-blue. Mucro as Fig. 62, apex plug-shaped. Juveniles with coarser Abd.5 graunalation ..... 6. *helena*
– Smaller, darker. Mucro as Figs. 48–52, apex upturned. Juveniles with fine, uniform granulation ..... 5. *concolor*
7. First unguiculus acuminate (Fig. 75) 8
– Unguiculus lamellate (Fig. 90) 10
8. Maxilla with strongly developed lamellae. Lam.1 much longer than capitulum, with long marginal filaments (Fig. 73). PAO lobes with finger-like projections (Fig. 76) ..... 9. *pannosa*
– Maxilla simple (as Fig. 56), lam.1 shorter, without long marginal filaments. PAO simple (Figs. 81, 82) 9
9. Body granulation coarse (Fig. 79). Pale species ..... 10. *ripperi*
– Body granulation fine. Dark species ..... 11. *devia*
10. Th.2–3 with seta m_6 present (Fig. 85). Maxilla strongly developed (Fig. 87) ..... 12. *oregonensis*
– Th.2–3 without m_6. Maxilla simple (as Fig. 56) 11
11. Dens with dorsoapical thorns (Fig. 101) ..... 13. *tooloki* n.sp.
– Dens smooth 12
12. Body with enlarged granules on Abd.4–6 (Fig. 91). Mucro as Figs. 92, 93 ... 14. *macrotuberculata*
– Body granulation fine, uniform. Mucro different 13
13. Dens about 2.5 as long as mucro (Fig. 114). Mucro as Fig. 115. Macrochaetae thick, ciliate ..... 15. *trybomi*
– Dens 3.0–3.5 as long as mucro (Fig. 117). Mucro as Fig. 116. Macrochaetae finer, nearly smooth ..... sp. near *trybomi*

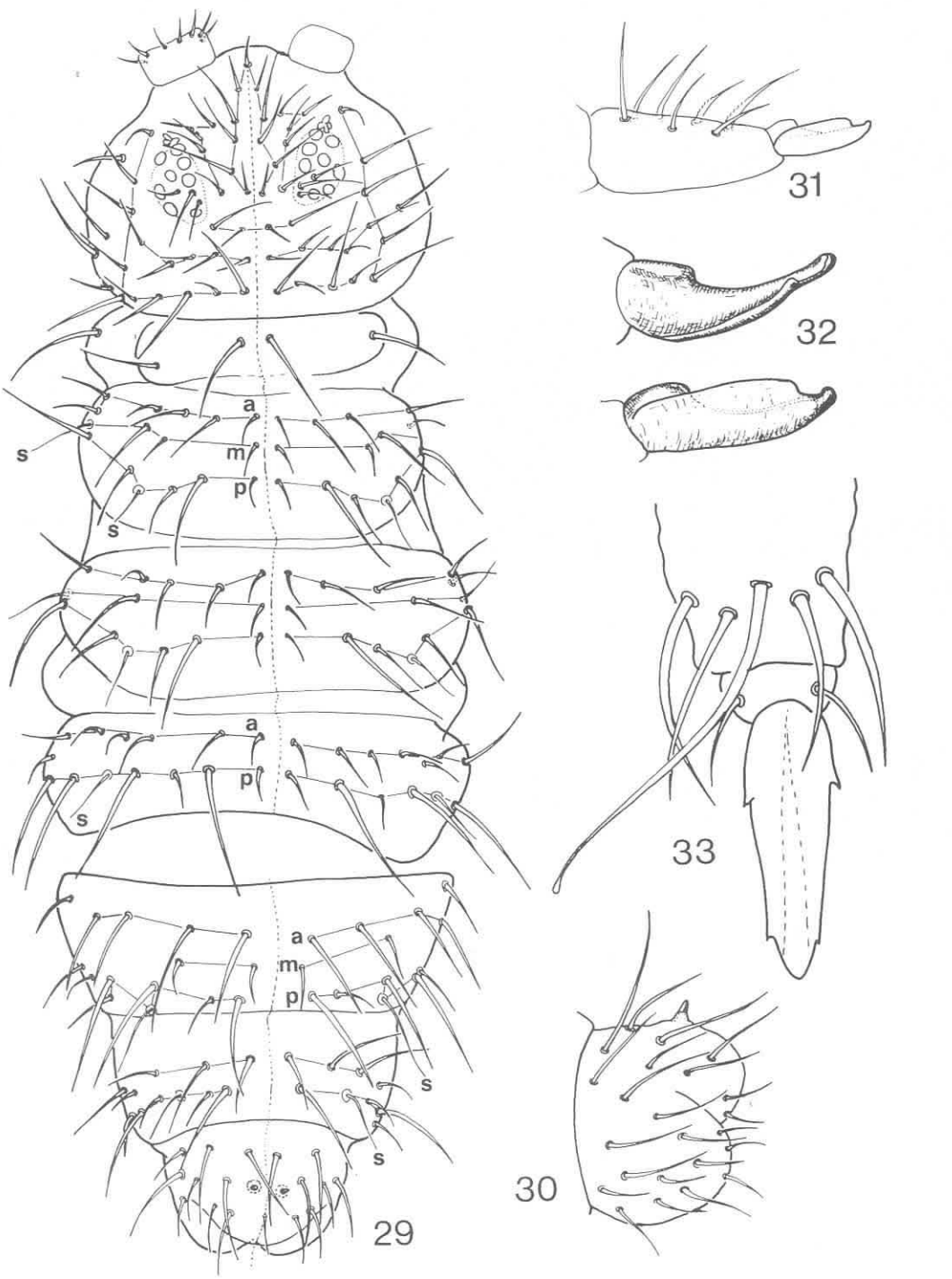
3. **Hypogastrura (H.) sensilis** (Folsom)

Figs. 34–43.

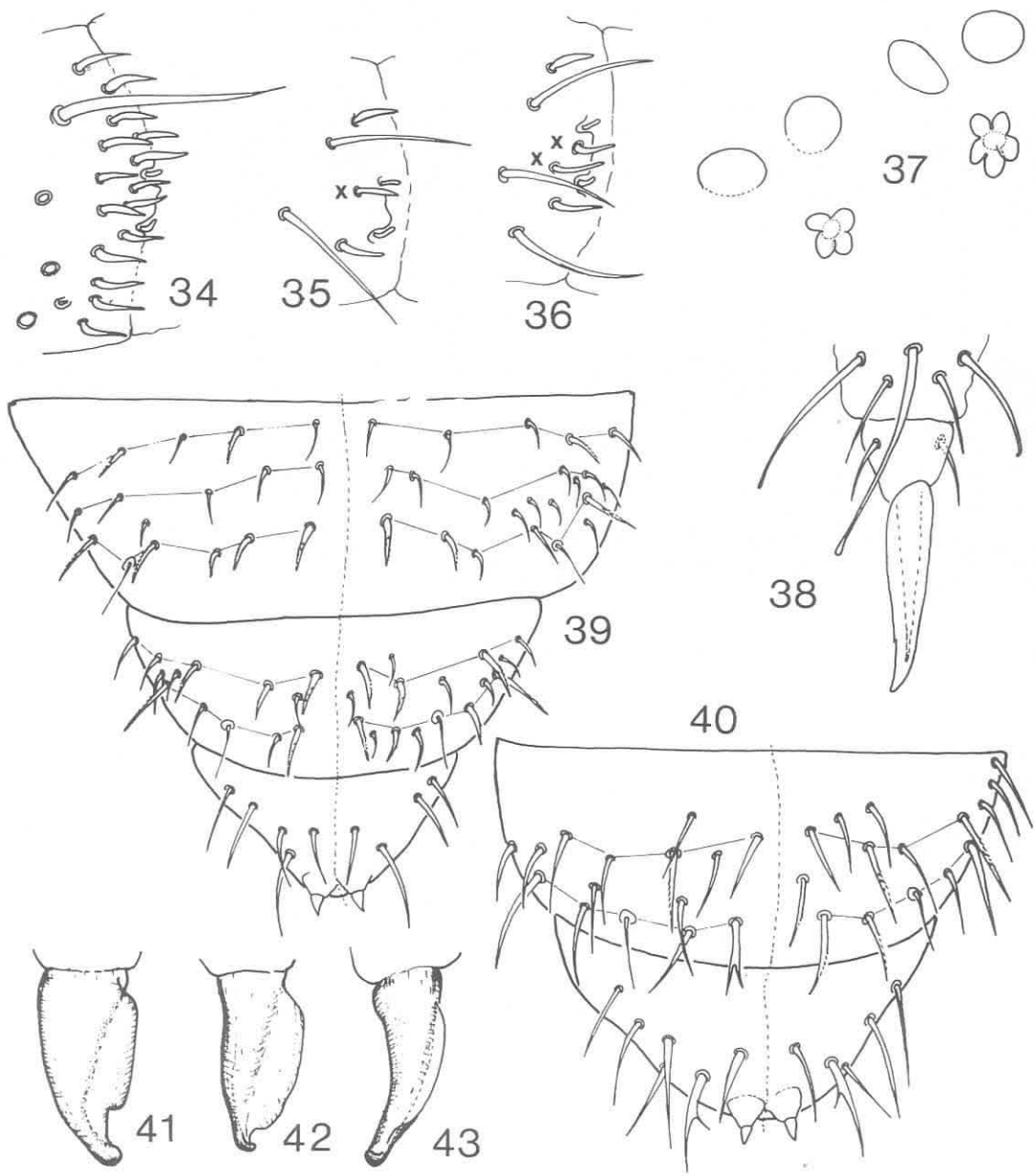
Achorutes sensilis Folsom, 1919: 5.

Description

Very similar to *tullbergi/concolor*, but generally larger (max. 2.0 mm) and always very dark, bluish-black. Distinctive features are mucro which is more curved with a broad, angular lateral lamella, dens which has 7 (sometimes 8 or 9) dorsal setae and tibiotarsi which have 1–2–1, 1–2–2 or 2–2–2 clavate tenent hairs (Fig. 38). Median hair always longer and thicker than others. On T_2 and T_3 the anterior tenent hair is reduced, never clavate. Ant. 3 organ variable from normal (only one guard spine at each side of the sensillae) to extremely spiny (Fig. 34). Abdominal chaetotaxy unstable, partly plurichaetotic (Fig. 39). Abd.5 often with 1 or 2 m_1 setae present. Anal spines variable from hooked, set on high papillae, to straight, spine-like set directly on the back without basal papillae. One or more of the Abd.6 setae may also be trans-



Figs. 29–33. *Hypogastrura navicularis*. — 29. Chaetotaxy of head – Abd.1 and Abd.4–6. — 30. Abd.6, lateral. — 31. Dens & mucro. — 32. Mucro, dorsal and lateral. — 33. Tip of tibiotarsus.



Figs. 34–43. *Hypogastrura sensilis*. — 34. Right Ant.3 organ. — 35. Right Ant.3 organ with 1 additional spine (x). — 36. Ditto with 2 additional spines. — 37. Right PAO, 2 different specimens. — 38. Tip of right T.2. — 39. Chaetotaxy of Abd.4–6. — 40. Abd.5–6 of a specimen with some split setae. — 41. Left mucro, lateral. — 42. Right mucro, oblique dorsal. — 43. Ditto, dorsal.

formed to spines. Tenaculum normally with 3+3 barbs, but specimens with 4+4 are also seen.

Discussion

The variation observed in number of spines in Ant. 3 organ is partly related to individual age/size. Small juveniles (0.6–0.7 mm) have none or only one additional spine, halfgrown and full-grown specimens have an increasing number. The species also shows allometry in development of hair cover. Large specimens have relatively much longer and thicker hairs, especially on the last abdominal segments. Split (furcate) hairs are frequent (Fig. 40). Development of antennal spines is apparently correlated with a simliar development of hair cover (length, thickness, furcations, pluri-chaetosis), possibly reflecting some particular physiological conditions of the individuals. But there are so far no indications that ecomorphosis, epitoky or cyclomorphosis are involved. However, in some samples even the largest adults have an antennal organ with at most one or two additional spines (Figs. 35, 36). These specimens also have a fine, short hair cover and split setae are not seen. Other differences between the forms are not observed.

The situation of the antennal organ is rather similar to the case of *tullbergi/concolor,* though here the allometric growth of the hair cover is found in the form with the normal antennal organ *(concolor)*, the other is always short-haired.

Distribution and ecology

Only found in N.Alaska (Prudhoe Bay, Barrow, Kotzebue) in bogs, shore debris and salt *Carex* meadows. – *Total distribution:* Northern Holarctic (N. Canada, N. Alaska, Chaun Bay, Spitsbergen (Ny Ålesund)).

Note: The Spitsbergen form is constantly short-haired with only 1 or 2 additional spines in Ant.3 organ.

4. **Hypogastrura (H.) tullbergi** (Schäffer)

Figs. 44–54.

Achorutes dubius Tullberg, 1876:39, nec Templeton, 1835:96.
Achorutes tullbergi Schäffer, 1900:244.
Hypogastrura concolor var. *setosa* Schött, 1923:7, syn.nov.
Hypogastrura spitsbergensis Stach, 1962:5, syn.nov.

Type locality: Siberia, Jenisej River.
Type material: Lectotype: One specimen (slide) labelled "Jenisejexpeditionen 1875, Achorutes dubius Tullb. Sibirien No.6. T.Tullberg". – *Paralectotypes:* One specimen (slide) labelled "Riksmuseets Entomologiska Afdelning. Achorutes dubius Tullb. Sibirien 25. Colleg. Jenisejexp. 75. Determ. T. Tullberg" and one (slide) labelled as above except locality which reads "Sibirien No.4". All specimens in coll. Naturhistoriska Riksmuseet, Stockholm.

The exact locality is not written on the label, but according to Schött (1893) the orginal material of *dubius* was collected from the following places along the river Jenisej: Kap Jefremow Kamen, Kap Krestowskoj, Kap Sapotschnaja Korga, Dudino, Goroschiskoj and Vorogova.

Description

Colour grayish-blue to dark bluish-black.
Size 1.5 mm.

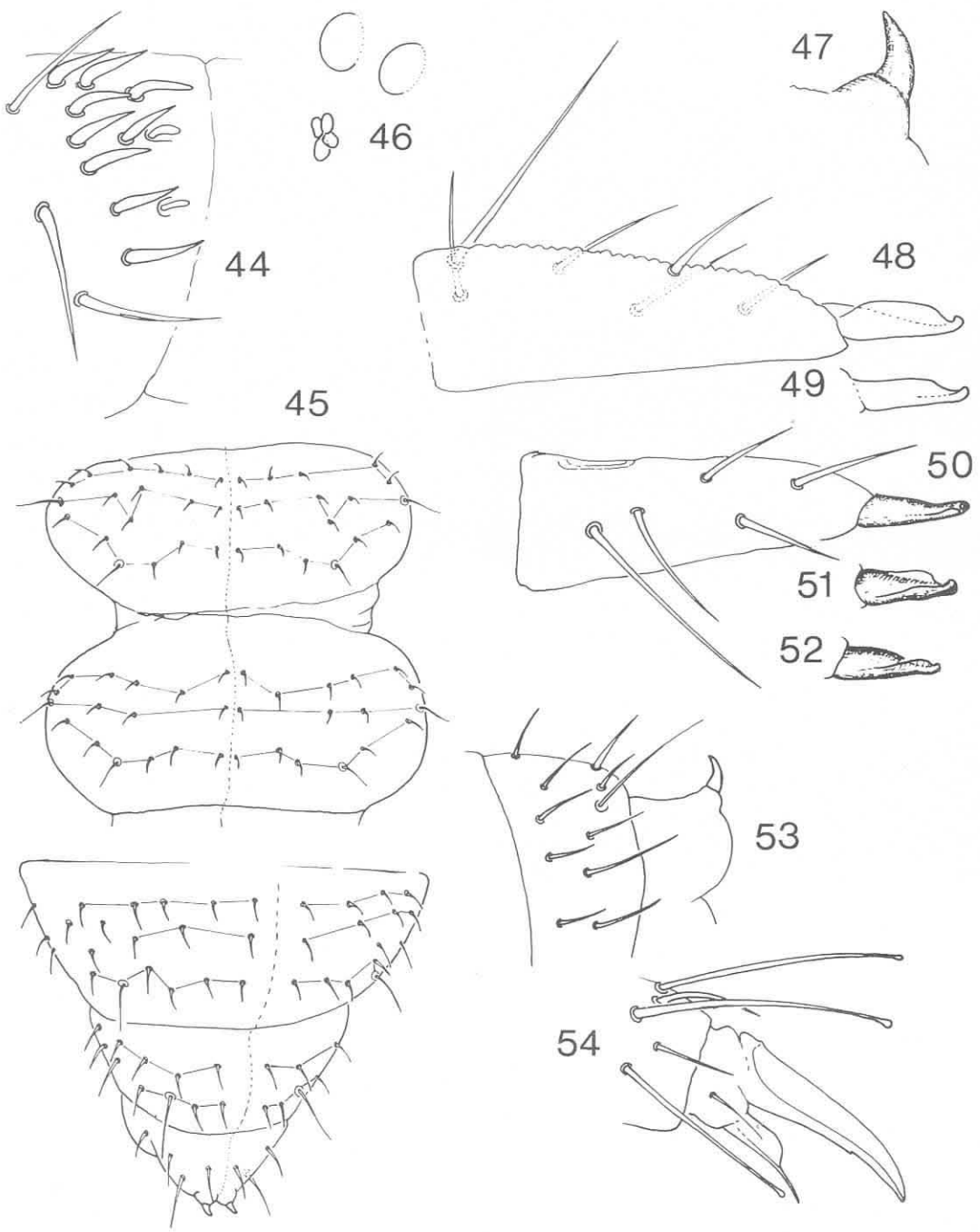
Head Ant.4 with unlobed apical bulb and no more than 5–6 ventral file setae. Ant.3 organ with many spine-like setae (Fig. 44). Juveniles with fewer spines. Ant.1 with 7 setae. PAO small, with 4 subequal lobes (Fig. 46). Maxilla simple, as Fig. 56. Max.o.l. with 2 sublobal hairs. Labrum as Fig. 55.

Body hairs short and fine, also in large individuals. On Abd.4–6 the hairs are somewhat coarser, often with a few serrations at apex. Chaetotaxy as Fig. 45. Head with 2+2 verticals. Body granulation fine, uniform. Tibiotarsi with 2–3–3 subequal clavate tenent hairs (Fig. 54). Ventral tube with 4+4 setae. Tenaculum with 3+3 teeth. Anal spines hooked, slightly higher than papillae.Dens normally with 5 setae, in large specimens often 6. Mucro about 1/3 as long as dens. Ventral edge weakly curved, apex upturned. Lateral lamella variable, usually narrow and slightly angular (Figs. 48–52).

Discussion

The above redefinition of *tullbergi*, based on type material, restricts this name to the form currently known as *spitsbergensis* Stach. The presence of additional spines in Ant.3 organ makes the species easily identifiable. Only *H. sensilis* has a similar organ, but that species differs by the broad mucro (Fig. 41).

The species was first described from Siberia and Novaja Semlja by Tullberg (1876) as *Achorutes dubius*. Schäffer (1900) changed the name to *Achorutes tullbergi* as Tullberg's combination was



Figs. 44–54. *Hypogastrura tullbergi*. — 44. Right Ant.3 organ, lectotype. — 45. Chaetotaxy of Th.2–3 & Abd.4–6 of Alaskan specimen. — 46. Left PAO, paralectotype. — 47. Anal spine, lectotype. — 48. Left dens & mucro (lateral), lectotype. — 49. Mucro of paralectotype. — 50. Left dens & mucro (dorsal), Alaskan specimen. — 51. Right mucro, oblique. — 52. Left mucro, lateral. — 53. Abd.5–6, paralectotype. — 54. Tip of left T.3, paralectotype.

preoccupied by Templeton (1835). Luckily, a few of Tullberg's original specimens are still present in Stockholm. Four syntypes were found, of which 3 are clearly "*spitsbergensis*" and the fourth is a different, unknown species. Schött (1923), working on material from Novaja Semlja, described the variety *setosa*, characterised by additional spines in Ant.3 organ. The material is kept in the Zoological Museum in Oslo, but the single slide specimen on which the variety was described, is not present. However, another specimen from the same material, identified by Schött as *H.concolor* var. *tullbergi*, has the antennal spines and is the same as Tullberg's *dubius*. The specimen was in alcohol and Schött probably never examined the antennal organ. Finally, Stach (1962) described the species from Spitsbergen under the name *H. spitsbergensis*. Although I have not seen the type specimens, the detailed description leaves no doubt about its identity.

The *tullbergi* of most recent workers – the form without antennal spines – is a mixture of several forms/species. One of these, present in the high Arctic, is described below as *H. concolor* Carpenter.

Distribution and ecology

So far only known from Barrow, Smith River (Lonely), Meade River and Kotzebue, but probably widespread in N. Alaska. At Meade River the species was abundant in a number of samples from both wet and dry habitats (dry meadows on sandy hills, dense "carpet" of moss and *Salix phlebophylla* on N-facing snow bed, litter of *Salix alaxensis* along river, flood debris and wet river bank vegetation etc.) In Spitsbergen (Ny Ålesund) I have collected the species from many habitats, of which most were dry meadows, moss/lichen heaths, dry cushion-plant communities in fellfields, etc. Also some records from wet moss in brooks. – *Total distribution:* Northern Holarctic.

5. **Hypogastrura (H.) concolor (Carpenter)**

Figs. 55–58.

Achorutes dubius var. *concolor* Carpenter, 1900:272.
Hypogastrura tullbergi auct. nec Schäffer, 1900:244.

Type locality: Cap Gertrude, Franz Josef Land.
Type material:*Lectotype*: One specimen (slide) labelled "C.Gertrude, Fr. Josef L. June 15.97, 126-1899. Achorutes dubius Tullberg var. concolor Carpenter. Hypogastrura concolor (Carp., 1900)" – *Paralectotypes*: 14 specimens (5 slide, 9 alc.) labelled as above. All in coll. National Museum of Ireland, Dublin.

Description

Colour dark bluish-black.
Size 1.5 mm.

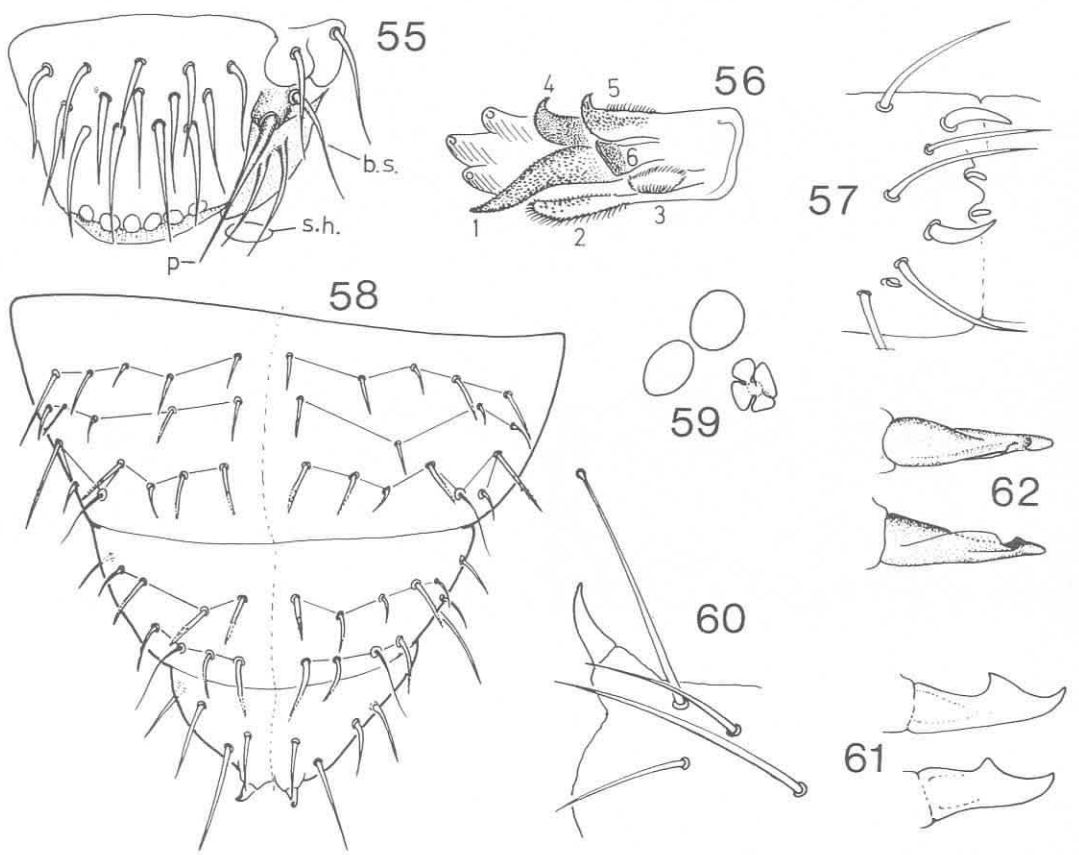
Head Ant.4 with unlobed apical bulb. Ventro-apical field with less than 10 file setae. Ant.3 organ with only 2 thick, spine-like guard setae (Fig. 57). Ant.1 with 7 setae. PAO 4-lobed, about as large as an eye. Maxilla as Fig. 56. Labrum with 5–5–4 setae, anterior edge with 6 papillae. Max.o.l with 2 sublobal hairs (Fig. 55).

Body. Chaetotaxy as in *tullbergi* (Fig. 45). Body hairs variable. In large specimens notably longer, thicker and more distinctly serrate than in small specimens. Probably it is the same kind of allometry observed in *H. oregonensis* (p. 28), though population differences may exist. Specimens from Canning River Delta are uniformly fine-haired, even mature adults. Body granulation fine, not distinctly coarser towards tip of Abd. Tibiotarsi with 2–3–4 clavate tenent hairs. Median hairs slightly longer than lateral ones, a little longer than claw. Ventral tube with 4+4 setae. Tenaculum with 3+3 teeth. Anal spines hooked, slightly longer than papillae. Claws with weak teeth, unguiculus more than 1/2 of inner unguis. Dens with 6 setae, rarely 5. Mucro as in *tullberi*, 1/4 – 1/3 as long as dens.

Discussion

This is probably the species called *tullbergi* by most recent workers. The name *tullbergi*, however, is now reserved for the arctic form with antennal spines (see above). The present form, having no antennal spines (apart from the 2 guard setae), may be a mixture of several species. The true *concolor*, verified from studies of type specimens, is widespread in the Arctic. The conspecificity with "*tullbergi*" from the southern states and continental Europe has to be verified.

Gisin (1963) and Valpas (1967) discussed the identity of *tullbergi* s.str. versus *concolor* (=*tullbergi* in the old sense) and concluded that *tullbergi* s.str. was probably just an endemic form of *concolor*. however, both in Alaska and Spitsbergen the two forms may be found together. Number of antennal spines is slightly variable in *tullbergi*, but



Figs. 55–62. — 55–58. *Hypogastrura concolor*. — 55. Labrum and maxillary outer lobe. p: Palp. s.h.: Sublobal hairs. b.s.: Basal seta. — 56. Maxilla. — 57. Right Ant.3 organ. — 58. Chaetotaxy of Abd.4–6. — 59–61. *Hypogastrura distincta*. — 59. Right PAO (syntype). — 60. Anal spine and surrounding setae (syntype). — 61. Mucro, 2 different syntypes. — 62. *Hypogastrura helena*. Mucro, dorsal and lateral.

there is no indication that presence/absence is linked to phenomena like ecomorphosis, cyclomorphosis or epitoky. In Spitsbergen *concolor* is always darker (nearly black) than *tullbergi* and has slightly stronger mucro, anal spines and body hairs. Either there is one dimorphic species, or two different species.

Distribution and ecology

North Slope (Canning River Delta, Prudhoe Bay, Barrow, Meade River, Franklin Bluffs at Sagavanirktok River, Toolik Lake). *Brooks Range* ("Last Spruce" S of Chandalar). The species is common and abundant, present in many samples from most of the above localities. The habitats range from very wet to very dry (bogs and wet brackish meadows on the arctic coast, *Salix/Alnus* litter along streams, dry moraine slope meadows, exposed pingo tops, etc.). Addison (1981) made a thorough study of the autecology of the species (identified as *H. tullbergi*)on Devon Island. – *Total distribution*:Northern Holarctic (Canada, Alaska, Chaun Bay, Franz Josef Land, Spitsbergen, Greenland).

6. **Hypogastrura (H.) helena** Christiansen & Bellinger

Fig. 62.

Hypogastrura helena Christiansen & Bellinger, 1980:118.

Description

My Alaskan material of this species is very similar to *concolor*. The main differences are as follows: Body larger (2.0 mm), colour paler (grayish-blue), dorsal granulation of Abd. 5–6 distinctly coarser than on anterior segments, claws with stronger teeth, mucro pointed, apex long, plug-shaped (Fig. 62).

Discussion

Following the key of Christiansen & Bellinger (1980), the Alaskan species will be identified as *helena*. However, the orginal description states that the abdomen is uniformly granulate, contrasting the enlarged granules on Abd. 5–6 observed in my specimens. Also the orginal figure of the mucro does not show the characteristic plug-shaped apex. There are several other related nearctic species/forms which are rather poorly described. Evidently much more work is needed to settle the systematics of this group.

Distribution and ecology

The Alaskan records indicate an Aleutian-Pacific distribution: Pribilof Isls. (St. Paul), Aleutian Isls. (Buldir, Amchitka), Kenai Peninsula (Kenai River). The type locality is in California. Christiansen & Bellinger (1980) add a dubious record from Barrow. Alaskan specimens are collected in grassy meadows.

7. **Hypogastrura (H.) distincta** (Axelson)

Figs. 59–61, 63, 64.

Achorutes distinctus Axelson, 1902:104.

Description

Colour paler or darker bluish-gray, sometimes nearly white with only eye spot dark.

Size 1.2 mm.

Head. Maxilla of *tullbergi* type (Fig. 56). Max.o.l with 2 sublobal hairs. PAO as Fig. 59.

Body. Macrochaetae on last 3 abdominal segments moderately differentiated. On Abd.4 setae p_4 and m_2 are truncate or weakly knobbed, so are m_2 on Abd.5 and the longest macrochaetae on Abd.6 (Fig. 64). Dens with 5 dorsal setae. Mucro $^1/_4$–$^1/_3$ as long as dens, the lateral lamella distinctly angular in middle (Fig. 61). Anal spines about $^1/_2$ of inner unguis on T.3.

Discussion

The combination of knobbed abdominal macrochaetae and 3–3–4 tenent hairs makes the species easily identifiable. The small tooth on mucro in the Alaskan specimens would make them key to *itaya* Kinoshita, following Christiansen & Bellinger (1980). However, no significant difference was found between Alaskan specimens and type specimens of *distincta* kept in the Zoological Museum, Helsinki. Two of six syntypes ("Kl. Joensuu, 12–14.X.01 WMA") were examined, showing a variable mucro (Fig. 61). Chaetotaxy was as in the Alaskan form, though only m_2 on Abd.6 were distinctly clavate (Fig. 63). Tenaculum was seen in one specimen, having 3+3 teeth. The anal spines were slightly more slender than in Alaskan specimens, about $^2/_3$ as long as inner claw 3 (Fig. 60).

Both anal spines and mucro are highly labile structures in *Hypogastrura* (Bourgeois & Cassagnau 1972), and the small differences described above probably indicate that there is only one species present. *H. ithaya* originally described from Japan, is a likely synonym of *distincta*.

Distribution and ecology

Only found once at Fairbanks in a compost heap of old hay and various stable debris, in company with *H.ripperi* and *Proisotoma minuta*. Probably introduced. – *Total distribution*: Holarctic.

8. **Hypogastrura (H.) perplexa** Christiansen & Bellinger

Figs. 65–69.

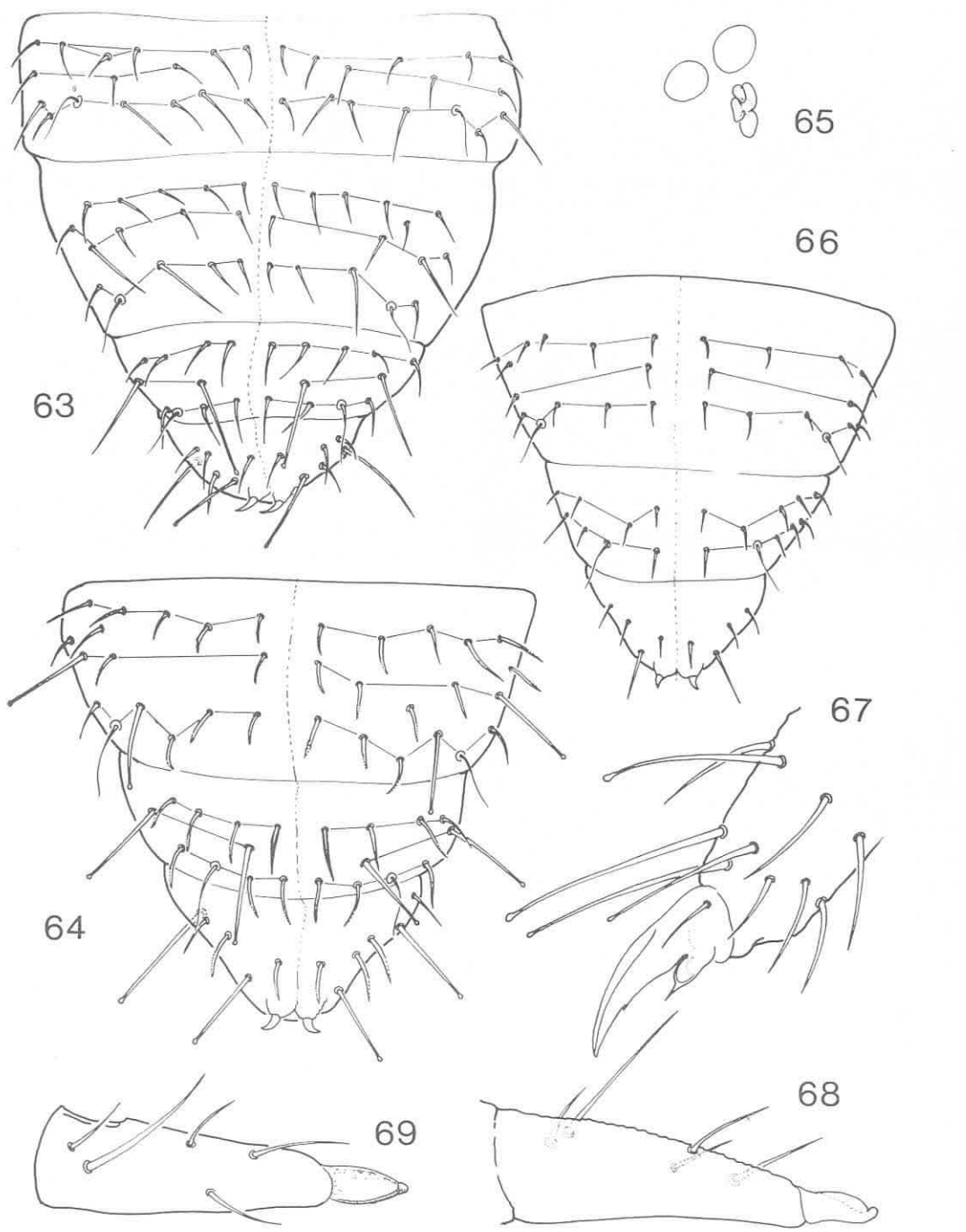
Achorutes macgillivrayi Folsom, 1916:488, nec Dalla Torre, 1895.
Hypogastrura perplexa Christiansen & Bellinger, 1980:124.

Description

Colour pale dirty yellowish to dark green. Ant. 3–4 darker, purple or bluish.

Size 1.4 mm.

Head. Ant.4 with simple apical bulb and 4–5 poorly differentiated blunt sensorial setae. Ant.3 organ normal. PAO about as large as an eye, with



Figs. 63–69. — 63–64. *Hypogastrura distincta*. — 63. Chaetotaxy of Abd.3–6 (syntype). — 64. Abd.4–6 of Fairbanks specimen. — 65–69. *Hypogastrura perplexa*. — 65. Right PAO. — 66. Abd.4–6. — 67. Tip of right T.3. — 68. Dens & mucro, lateral. — 69. Ditto, dorsal.

4 lobes. Anterior pair slightly enlarged. Labrum and maxilla as in *concolor* (Figs. 55, 56).

Body granulation fine, uniform. Body hairs short and fine, much like *tullbergi*. Chaetotaxy as Fig. 66. Abd.4 often with p_3 absent. Abd.5 usually without p_2, probably because of the backward position of a_2. On Th.2 seta m_2 present or absent. Dens with 5 or 6 dorsal setae. Mucro somewhat variable, usually boat-shaped with simple, curved lateral lamella (Fig. 68). Tibiotarsi with 2–3–4 clavate tenent hairs. Ventral tube with 4+4 setae. Tenaculum with 3+3 teeth. Claws without lateral teeth, inner edge of unguis with a fine tooth. Unguiculus very short, only 1/3–1/4 as long as inner unguis (Fig. 67).

Discussion

The above description is based on a single sample from Prudhoe Bay. The unusual colour in combination with 4 clavate tenent hairs on T.3 and very short unguiculus, readily separates this form from other Alaskan species. Though its identity with *perplexa* is far from definite. According to Christiansen & Bellinger (1980) *perplexa* and related species have the unguiculus at least 1/2 as long as the inner unguis. However, upon inspection of some of my specimens, Christiansen says they fall partly within the range of general variation found in *perplexa*.

Distribution and ecology

Only found once in a wet moss/*Carex* bog at Prudhoe Bay (Pt. McIntyre). Christiansen & Bellinger (1980) reports the species from Cook Inlet. – *Total distribution:* Nearctic.

Note: Christiansen & Bellinger (1980) reports the species *H. humi* (Folsom) from Barrow. It differs from *perplex* in having 3 clavate tenent hairs on $T.1_3$, a condition rarely found in typical *perplexa*. Also the unguiculus is said to be slightly longer (0.7–0.9 of inner unguis). Given no other differences, the Barrow *humi* and Prudhoe Bay *perplex* are hardly separate species.

9. **Hypogastrura (H.) pannosa** (Macnamara)

Figs. 70–76.

Achorutes pannosus Macnamara, 1922:153.
Hypogastrura essa Christiansen & Bellinger, 1980:68, syn.nov.

Description

Colour grayish-blue, large specimens nearly black. Ventral side paler.

Size 1.2 mm.

Head. PAO with 4 (5) lobes. Lobes somewhat irregular with an upright, finger-like papilla in proximal part (Fig. 76). Maxilla characteristic (Fig. 73). Lam.1 broad, reaching far beyond tip of maxillary teeth. Apical part fringed with long filaments. Inner side with many spine-like denticles. Lam.5 with a prominent sagittate dorsal crest and a shoulder-like denticulate part.

Body. Claws and apical part of tibiotarsus as Fig. 75. Dens and mucro as Figs. 70, 71. Mucro quite variable. Dorsal lamella with a distinct tooth or more or less gradually narrowed. Chaetotaxy as in *ripperi* (Fig. 79).

Discussion

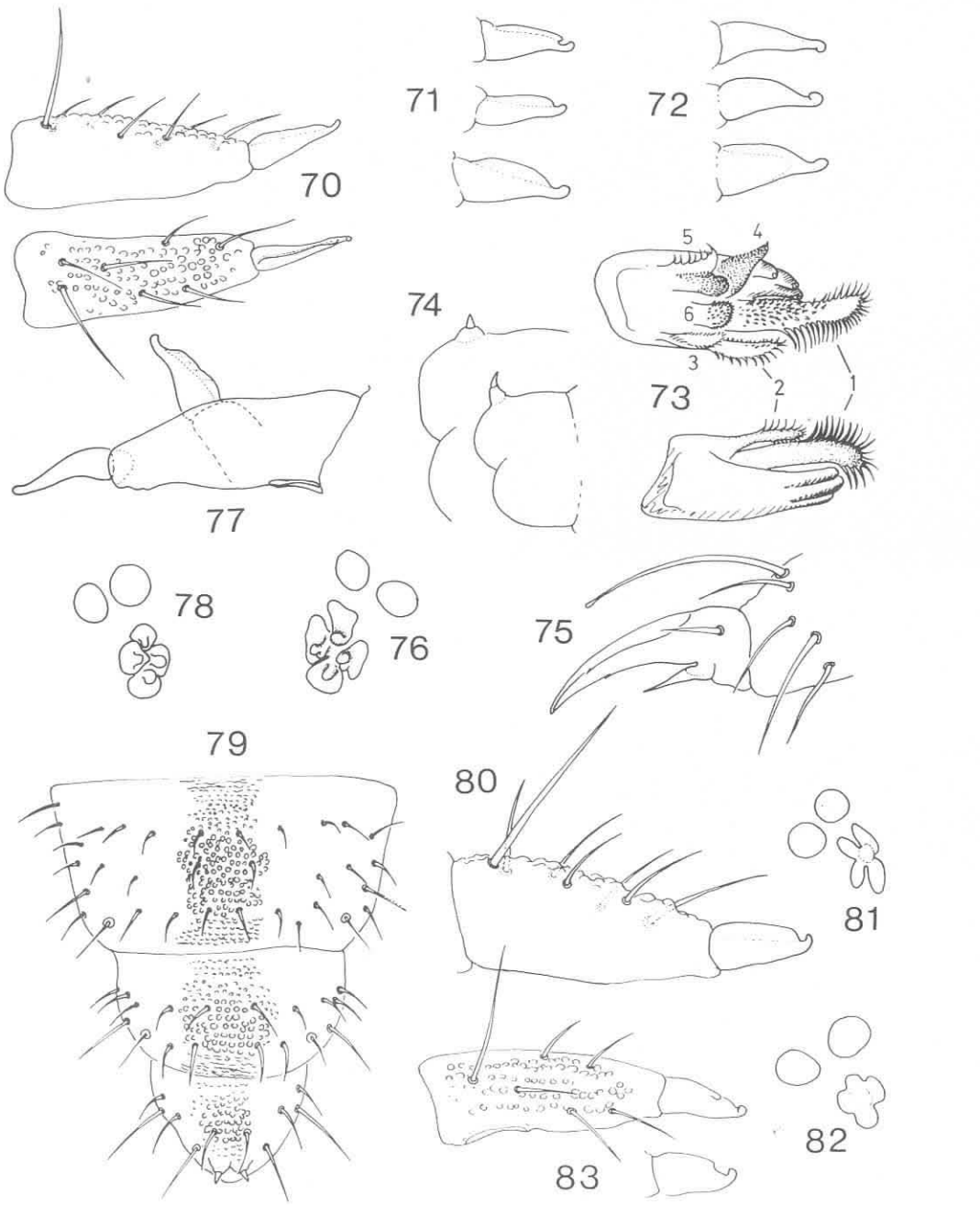
The Alaskan populations appear rather homogenous, with one notable exception: Specimens from sand dunes at Prudhoe Bay are all paler and smaller and with a more slender body than the main form. Also the mucro is relatively shorter with less marked dorsal lamella (Fig. 72). The same form is seen in material collected on the north coast of Baffin Island in Canada (Cape Hatt, 15.VIII.1981. E.Sendstad leg.).

The general Alaskan form was compared to a sample from Pima Co., Arizona (det. Christiansen), and no differences were found. The Arizona sample had lots of juveniles which were clearly ecomorphic. Mouthparts were reduced, granules on Abd.5–6 enlarged and anal spines shortened.

As the description of *essa* Christ. & Bell. comes very close to *pannosa*, the holotype and two paratypes of the former were examined. The maxillae are identical to *pannosa*, PAO has the same peculiar finger-like processes and mucro is of the same shape (Figs. 77, 78). The only notable differences are a slightly coarser granulation on Abd.5–6 in *essa* and slightly longer mucro in relation to dens. In view of the well documented intraspecific variation in these characters (Cassagnau 1972), I see no reason to keep *pannosa* and *essa* as separate species.

Distribution and ecology

Scattered records from *North Slope* (Barrow, Prudhoe Bay, Lonely at Smith River), *Central*



Figs. 70–83. — 70–76. *Hypogastrura pannosa*. — 70. Dens & mucro, lateral, dorsal. — 71. Mucro, 3 different specimens. — 72. Mucro (dorsal, oblique dorsal, lateral) of Prudhoe Bay form. — 73. Maxilla, inner and outer side. — 74. Abd.6 with anal spines, 2 different specimens. — 75. Tip of left T.1. — 76. PAO. — 77–78. *Hypogastrura essa*. — 77. Dens & mucro, holotype from Massachusetts. — 78. PAO, holotype. — 79–81. *Hypogastrura ripperi*. — 79. Abd.4–6 with granular differentiation. — 80. Dens & mucro, lateral. — 81. PAO. — 82–83. *Hypogastrura devia*. — 82. PAO. — 83. Dens & mucro, dorsal, lateral.

(Yukon Bridge, Fairbanks at Tanana River and Spinach Creek, Eagle Creek at Mastodon Dome) and *Alaska Range* (Summit Lake N of Paxson, Denali Hwy. E of Susitna Lodge, Alaska Hwy. at Northway). Usually found in damp debris and vegetation along lakes and streams. At Barrow in salt *Carex* meadow. The sample from dry sand dunes (*Elymus, Artemisia, Potentilla, Polemonium*) at Prudhoe Bay may represent a different species (see above). – *Total distribution*: Nearctic.

10. **Hypogastrura (H.) ripperi** Gisin

Figs. 79–81.

Hypogastrura ripperi Gisin, 1952:1.

Description

Colour pale bluish-gray, sometimes nearly white.

Size 0.9 mm (mature).

Head. PAO with 4–5 lobes. Anterior pair distinctly enlarged (Fig. 81). Maxilla with short, undifferentiated lamellae.

Body. Dens and mucro as Fig. 80. Body granulation coarser than in related species, notably on last abdominal segments (Fig. 79).

Discussion

The pale colour, coarse granulation, mucro shape and simple maxillae makes the species easily identifiable.

Distribution and ecology

Only found once in a compost heap at Fairbanks, in company with *H. distincta* and *Proisotoma minuta*. Probably introduced. – *Total distribution:* Holarctic.

11. **Hypogastrura (H.) devia** Christiansen & Bellinger

Figs. 82, 83.

Hypogastrura devia Christiansen & Bellinger, 1980:66

Description

Colour bluish-black.

Size 1.3 mm.

Head. Maxilla simple, as in *concolor* (Fig. 56). PAO with 4 (3–5) blunt lobes (Fig. 82). Dens and mucro as Fig. 83.

Body. Tibiotarsal tenent hair sometimes indistincly clavate. Chaetotaxy of last abdominal segments as in *ripperi* (Fig. 79). Body granulation fine, uniform.

Discussion

A characteristic, dark species. Mucro resembles *ripperi* but this is a much paler species with coarse abdominal granulation, and would hardly be found in the Arctic.

Distribution and ecology

The species was described from Pt. Barrow. My own records are from salt meadows and shore debris at Barrow and Prudhoe Bay (several samples). – *Total distribution*: Nearctic.

12. **Hypogastrura (H.) oregonensis** Yosii

Figs. 84–88.

Hypogastrura oregonensis Yosii, 1960:276

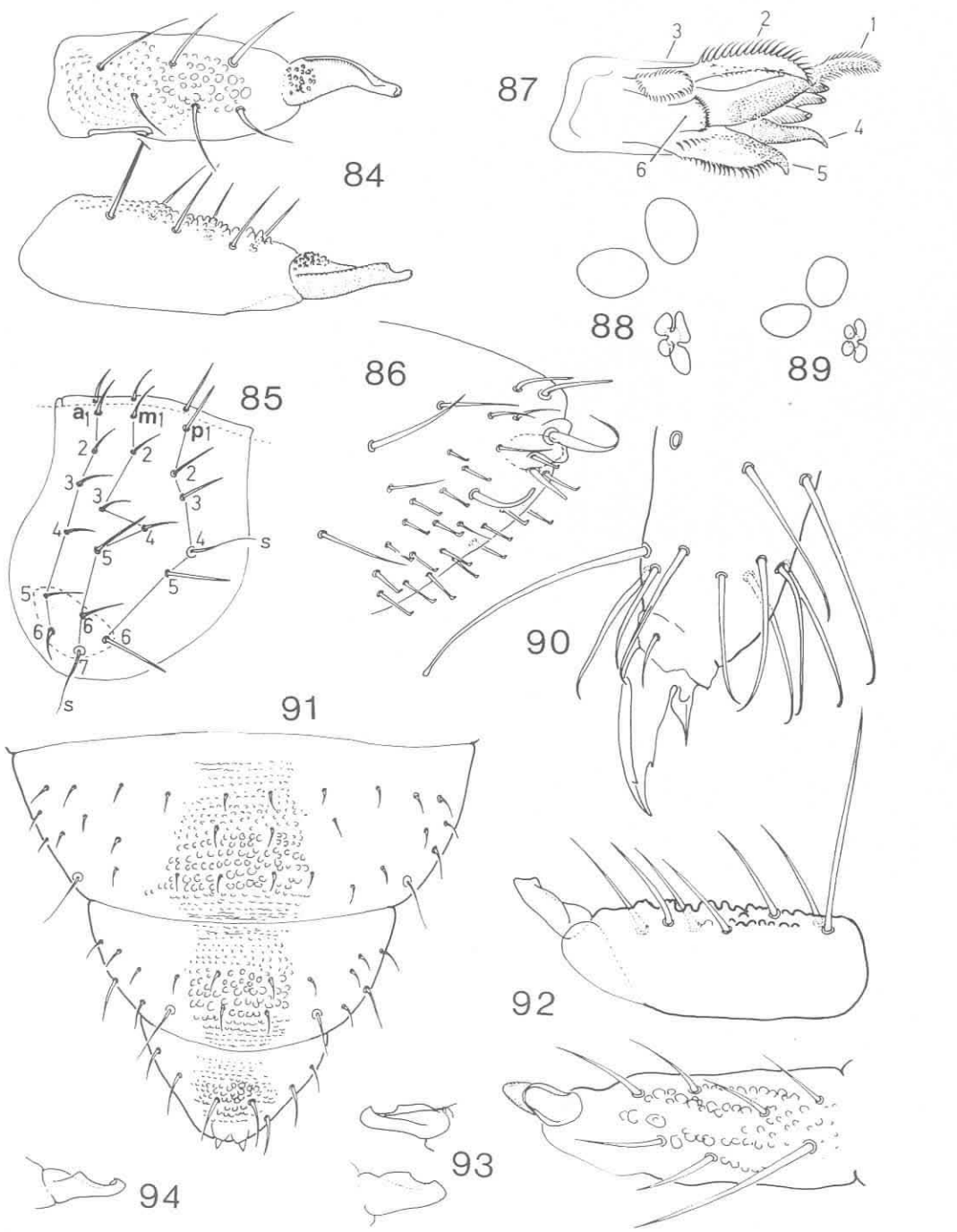
Description

Colour paler or darker brownish-gray.

Size 1.5 mm.

Head. Ant. 4 with a deeply withdrawn apical bulb and a moderately developed ventral file (Fig. 86). PAO about as large as an eye (Fig. 88). Maxilla characteristic. Lam.1 much longer than teeth, with distinct marginal filaments. Lam.2 with prominent, long filaments along ventral edge. Lam.6 with a "scraper" along anterior edge, none or few denticles in central part.

Body. Granulation fine and uniform. Body hairs variable from rather short and fine to long, thick and distally serrate, especially in large individuals (allometry). Differentiation in macro/microchaetae poor. Chaetotaxy variable. Th. 2–3 as Fig. 85, with m_6 present in the lateral group. Specimens with p_2 absent on Abd.5 are seen. Tibiotarsal tenent hair acuminate. Mucro strongly curved, blunt-tipped, with an angular lateral lamella. Basal part often with granules (Fig. 84). Granulation on dens variable, in distal part usually enlarged to finger-like papillae; specimens with fine and



Figs. 84–94. — 84–88. *Hypogastrura oregonensis*. — 84. Dens & mucro, dorsal, lateral. — 85. Chaetotaxy of Th.2, left side. — 86. Ventroapical file of Ant.4. — 87. Right maxilla, inner side. — 88. Right PAO. — 89–94. *Hypogastrura macrotuberculata*. — 89. Right PAO. — 90. Tip of T.1. — 91. Abd.4–6 with granular differentiation. — 92. Dens & mucro, lateral, dorsal. — 93. Mucro, different specimens. — 94. Left mucro, type specimen.

nearly uniform granulation are, however, frequent. Dens with 6–7 dorsal setae.

A rather stout and thick species, somewhat *Pseudachorutes*-like.

Discussion

The characteristic mucro, maxilla and long, thick and uniform abdominal hairs (large specimens) make this species easy to identify. Also the presence of m_6 on Th. 2–3 appears to be unique among *Hypogastrura* s.str., not seen in any other Alaskan species though it is present in members of *Ceratophysella* (*denticulata* group). The fairly strong antennal file in *oregonensis* also points to *Ceratophysella*, probably reflecting a rather isolated systematic position of the species.

Hammer's (1953) redescription of *H.trybomi* (Schött) from Canada comes rather close to *oregonensis*. Following the key of Christiansen & Bellinger (1980), specimens of *oregonensis* with fine dental granulation will key out as *trybomi*. Several authors have probably confused the species. *H. trybomi* is described below from the Siberian type material.

Distibution and ecology

Common and widespread except in extreme north. *North Slope* (Franklin Bluffs, Toolik Lake), *Bering Area* (Cape Krusenstern, Kotzebue, Nome, Chevak, Nunivak Isl., Pribilof Isl.), *Central* (Prospect Camp, Kanuti River, Yukon Bridge, Fairbanks, Mastodon Dome), *Alaska Range* (Summit Lake at McKinley Park, Denali Hwy. 120 mi from Paxson), *S.E Coast* (Kenai River). Generally found in rather damp places (willow/alder litter along streams, bog, wet meadows etc.). Two records from fresh fungi. – *Total distribution:* Nearctic (Pacific and Cordillera) – E. Palaerctic (Chaun Bay).

13. **Hypogastrura (H.) tooliki** n.sp.

Figs. 95–98, 100–103, 105, 106.

Type locality: Alaska. Brooks Range. Dietrich Pass at water divide.
Type material: *Holotype*: One specimen (alc.) from "Alska. Brooks Range. Dietrich pass, 5.000ft. 20.VIII.1976. Wet moss near melt water brooks. A.Fjellberg leg.", at USNM. – *Paratypes*: 61 (57 alc., 4 slides) as above, at USNM. 20 (alc.) as above, at BM. 3 (slide) as above, at AF. 29 (alc.) from "Alaska. Taylor Hwy., Mt. Fairplay, mi. 33. 19.IX.1976. Moss, willow, *Carex* above tree line. K.Metzner leg.", at MCZ. 10 (slide) as above, at AF. 5 (alc.) from "Alaska. Canning River Delta, 23.VIII.1980. Mossy swale. S.F. MacLean leg.", at MCZ. 7 (slides) as above, at AF. 128 (120 alc., 8 slide) from "Alaska. Alaska Range. Richardson Hwy., Triangle Peak, 1480 m. 9.VIII.1980. Wet moss. A. Fjellberg leg.", at MCZ. Ca. 100 (alc.) as above, except altitude which reads "1900 m", at MCZ. 9 (slide) from "Alaska Range. Clearwater Mts. E of Susitna Lodge. 30.VII.1980. Wet moss, middle alpine. A.Fjellberg leg.", at MCZ. 27 (22 alc., 5 slides) from "Alaska. Prudhoe Bay, Pt. McIntyre. 16.VIII.1976. Wet Carex bog. A.Fjellberg leg.", at MCZ. 7 (slide) as above, at AF. 22 (alc.) from "Alaska. Brooks Range. "Last Spruce" S of Chandalar. 20.VIII.1976. Moist Alnus litter. V.Behan leg.", at MCZ. 6 (slide) as above, at AF. 2 (slides) from "Alaska. Washington Creek N of Fairbanks. 28.VII.1976. On water in small brook in black spruce taiga. A.Fjellberg leg.", at MCZ. 5 (slides) from "Alaska. Brooks Range. Mts. W of Atigun Camp, 5.800 ft. 19.VIII.1976. Dry moss on stone. A.Fjellberg leg.", at MCZ. 22 (17 alc., 5 slide) from "Alaska. Meade River, Atkasuk. 26.VIII.1976. Wet moss. A.Fjellberg leg.", at MCZ. 18 (12 alc., 6 slide) as above except "28.VIII.1976. Shore debris at lake", at MCZ. 21 (17 alc., 4 slide) as above except "Rich meadow", at MCZ.
Derivation of name: After Toolik Lake.

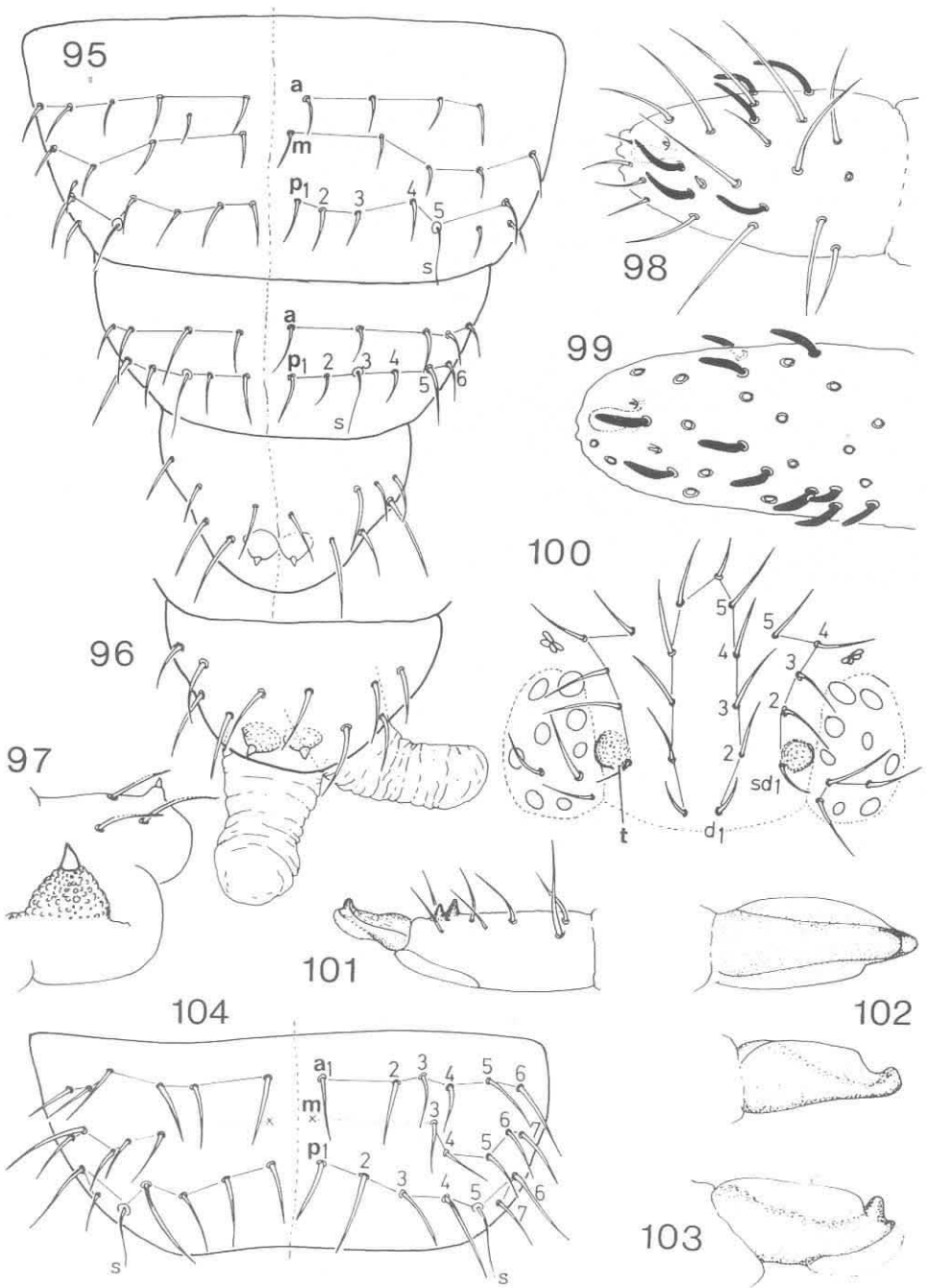
Description

Colour brownish-black (violet black in fresh specimens).

Size 1.5 mm.

Head. Ant.4 with simple apical bulb and 6–7 blunt sensorial hairs, usually 3 dorsal and 3 lateral (Fig. 98). Ventral file with at most 6–7 modified setae. Ant.3 organ normal. Ant.1 with 8 setae. PAO about as large as an eye, with 4 lobes. Anterior pair slightly enlarged (Fig. 106). Head with a prominent tubercle on each side outside seta sd_1 (Fig. 100). Labrum with 5–5–4 curved, spine-like setae. Apical edge with 4 lobes and 5 subapical blunt ridges. Maxilla with short, undifferentiated lamellae. Maxillary outer lobe with 2 sublobal hairs. Head with 2+2 vertical setae.

Body. Chaetotaxy as Fig. 95. Hairs short, acuminate, slightly differentiated. Longest setae weakly serrate. Body granulation fine, uniform. Anal spines small, on subterminal high papillae (Fig. 97). Unguis with inner tooth and a pair of subapical lateral teeth. Unguiculus broadly lamellate, reaching middle of unguis inner edge(Fig. 105). Tenent hair moderately clavate. Ventral tube with 5+5 (4–6) setae. Tenaculum with 4+4 teeth. Furca strong, mucro more than 1/3 as long as dens. Dens with 7 setae and 2–3 subapical strong, conical teeth. Dorsal granulation on dens other-



Figs. 95–104. — 95–98. *Hypogastrura tooliki* n.sp. — 95. Chaetotaxy of Abd.4–6. — 96. Abd.6 with extruded anal sacs. — 97. Abd.6 with anal spine (detail). — 98. Left Ant.4. Sensillae black. — 99. *Hypogastrura socialis*. Sensillae of left Ant.4, Norwegian specimen. — 100–103. *Hypogastrura tooliki*. — 100. Chaetotaxy of central part of head. t: Tubercle. — 101. Dens & mucro. — 102. Left mucro, dorsal, lateral. Summer form. — 103. Left mucro, lateral. Supposed winter form. — 104. *Hypogastrura nivicola*. Chaetotaxy of Abd.4. Note absence of m_1. Specimen from New Hampshire.

wise fine. Ventroapical half of dens smooth, without visible granulation. Mucro either blunt-tipped (Fig. 102) or with small ventroapical tooth and variable hyaline ventral swelling (Fig. 103). The swelling may be an artifact caused by the slide medium, but it is only present in the one form. Both forms have broad, angular lateral lamella and a gradually tapering lamella along inner edge. Specimens with exposed anal sacs are frequent (Fig. 96)

Discussion

The species is rather variable in many characters. Although not yet proved, the two mucro forms probably represent the summer/winter forms of a cyclomorphic species. The supposed winter form (Fig. 103) was only found in colder or northern sites, collected in August – September (Meade River, Dietrich Pass, Mt. Fairplay). At Meade River the population was a mixture of both forms on 28 August. At this time other cyclomorphic species (*Isotoma neglecta*) were transforming from summer to winter forms in N. Alaska (Fjellberg 1978, fig. 20). Leinaas (1981) found cyclomorphosis in the European species *H. socialis*, belonging to the same species complex as *tooliki*, and Christiansen & Bellinger (1980) indicated cyclomorphosis in *H.nivicola*, another member of the group.

Morphological variation, which probably reflects population differences rather than seasonal changes, involve length of anal spines, mucro, tibiotarsal tenent hair and body hairs in general. Specimens from Meade River and "Last Spruce" S of Chandalar have particularly long body hairs and tenent hairs, with coarse dorsal granulation on dens.

H. tooliki belongs to the *nivicola* group with the nearctic members *nivicola* (Fitch), *harveyi* (Folsom) and *notha* (Macnamara). The two last species are distinguished by their long, blunt-tipped or knobbed macrochaetae. Judging from various samples of *nivicola*, that taxon consists of several Nearctic species none of which corresponds to the Alaskan form. The species supposed to be the true *nivicola* is easily identified by having only 1+1 verticals on head (v_1 absent) and only 2+2 setae along median line of Abd.4 (m_1 absent, Fig. 104). The European *socialis* (Uzel) differs by the increased number of lateral sensillae on Ant.4 (Fig. 99)

Distribution and ecology

Many records from North Slope, Brooks Range and Alaska Range (see type material above). Apparently most common in wet sites in arctic and alpine tundra. Only once from a taiga habitat in Central Alaska. Mass occurrence is obseved in damp moss near snow in the mountains. The species was also found in several samples from Washington (Mt. Rainier and Wenatchee Mts.) – *Total distribution*: Nearctic.

14. **Hypogastrura (H.) macrotuberculata** (Hammer)

Figs. 89–94.

Neogastrura macrotuberculata Hammer, 1953:13

Description

Colour uniform pale grayish-blue to dark brown black.

Size 1.2 mm.

Head. Ant.4 with simple apical bulb and 6–8 blunt sensorial setae. Only a few (5–6) ventroapical file setae are present. Ant.3 organ normal. Ant.1 with 7–8 setae (variable). PAO slightly smaller than an eye, with 4 lobes. Anterior pair slightly enlarged. Maxilla simple, of the *tullbergi* type (Fig. 56). Max.o.1 with 2 sublobal hairs. Head normally with 1+1 vertical setae, sometimes 1+2 or 2+2.

Body. Body hairs short and fine, macrochaetae hardly differentiated from ordinary setae, smooth. Chaetotaxy as Fig. 91. Abd.5 with only 1+1 p-setae between the sensillae (p_2 absent). Th.2 generally without m_2. Body granulation rather coarse, notably in median part of posterior tergites. Claws rather short, unguis with distinct inner tooth. Unguiculus lamellate. Tenent hair weakly clavate (Fig.90). Ventral tube with 4+4 or 5+5 (6) setae. Tenaculum with 4+4 teeth. Dens with 7 dorsal setae and some coarser dorsal tubercles arranged in more or less clear rows (Fig. 92). Mucro boat-shaped, rather small (about 1/3 of dens). Lateral lamella variable, usually distinctly angular. Apex also variable, sometimes distinctly hooked (Fig. 93). Anal spines terminal, short and stout, about as high as papillae.

A rather small, stout, short-haired species.

Discussion

The above description is based on Alaskan specimens. The single type specimen (labelled "Type. Collembola. Canada 1948. Reindeer Stn.132. Neogastrura macrotuberculata n.sp. M. Hammer", Biosystematics Research Institute, Ottawa) was also examined. Although few details could be seen, the mucro, tibiotarsus, anal spines and Ant.4 do not differ from Alaskan specimens.

Distribution and ecology

Many records from north and central Alaska. *North Slope* (Cape Thompson, Canning River Delta, Franklin Bluffs, Toolik Lake), *Brooks Range* ("Last Spruce" S of Chandalar), - *Central* (Sukakpak Mt., Prospect Camp, Fairbanks (many records)), *Alaska Range* (Watana Mt. in the Talkeetna Mts.). Most records are from rather dry plant communities (moss and litter in white spruce taiga, dry alpine/arctic meadows etc.). Some of the N. Slope records are from damper sites. – *Total distribution:* Nearctic.

15. **Hypogastrura (H.) trybomi** (Schött)

Figs. 107–115.

Achorutes trybomi Schött, 1893:82.

Type-material: The following description is based on 24 syntypes (of which two were cleared, dissected and mounted) from "Vegaexp. Achorutes Trybomi n.sp. Probraschinje. Determ. H. Schött", which are kept in Naturhistoriska Riksmuseet, Stockholm. The type locality is Preobraschenie Isl. in Chatanga Bay, E of the Taimyr Peninsula. 74°45'N.

Description

Colour black.

Size. Schött (1893) stated 1 mm. The largest syntype is 1.3 mm and is slightly rolled up. Full size will probably be 1.5–1.7 mm.

Head. Ant.4 with a deeply withdrawn unlobed apical bulb. Blunt sensorial setae hair-like, slender. Ventral file weak with about 10 file setae. Ant.3 organ normal. Ant.1 with 7 setae. PAO about the size of an eye, posterior lobes more or less fused (Figs. 112, 113). Labrum with 5–5–4 heavy, spine-like setae. The 4 anterior somewhat thicker than the others. Maxilla simple (Fig. 110). Maxillary outer lobe with 2 sublobal hairs. Head with 2+2 vertical setae, the median pair smaller.

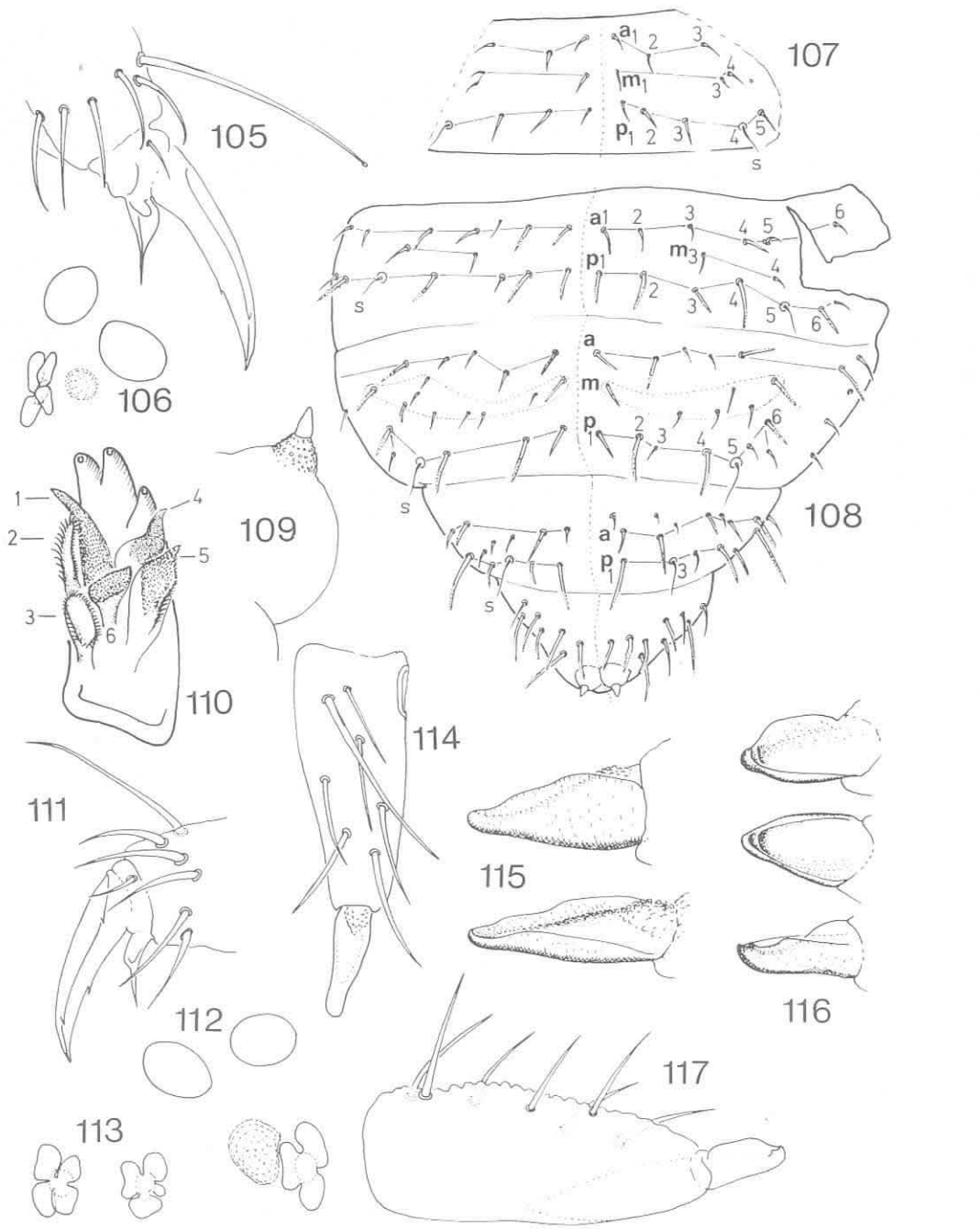
Body. Chaeotaxy of Th.3 and Abd.3–6 as Figs. 107, 108. Body hairs distinctly ciliate, notably the macrochaetae which are thick, blunt-tipped. Supernumerary and asymmetric setae are frequent. Body granulation very fine, uniform. Anal spines short, straigth, about as high as papillae (Fig. 109). Tibiotarsi with acuminate tenent hair. Unguis with distinct inner tooth and 2 pairs of lateral teeth. Unguiculus lamellate, reaching middle of inner unguis (Fig. 111). Dens about 2.5 as long as mucro, with 7 dorsal setae, all slender. Mucro straight, blunt. Lamellae undulating, not angular. Basal part with some rough granules (Fig. 115). Ventral tube with 6+6 setae. Tenaculum with 4+4 teeth.

Discussion.

Apart from the original Siberian record, no further definite records are known. Reports from Canada (Hammer 1953) and Japan (Yosii 1972 as *H.theeli* (Tullberg)) are probably wrong or should at least be verified. Judging from Yosii's description and figures of the Japanese form, that speces may actually be *H. oregonensis*. The synonymication of *trybomi* with *theeli* refers to Schött (1902). Tullberg (1876) described *theeli* from Novaja Semlja. Unfortunately the type material appears to be lost. In Naturhistoriska Riksmuseet, Stockholm, there is a vial labelled "Achorutes theeli Tullb. Nov. Semlja, Möllerfj. Colleg. Jenisejexp. 75. Determ. T. Tullberg", but the vial only contains a large number of *Xenylla humicola*. The labels may have been mixed at some time, but when searching in vials with *humicola* from the same expedition I found nothing corresponding to *theeli*.

From Barrow and Smith River (Lonely) I have a few sample of a form that comes close to *trybomi*. It differs by having more hairs on ventral tube (up to 9+9), hardly visible lateral teeth on unguis, thicker sensorial setae on Ant.4, body hairs less differentiate and not so strongly ciliate, and above all, by shape of mucro (Fig. 116). Mucro is shorter (dens/mucro about 3.5, Fig. 117), spoon-shaped with a distinct "shelf" just behind tip.

Another possible candidate of the Alaskan form is *H.sahlbergi* (Reuter), of which I have some specimens from Norway (Lakselv). These specimens differ from the Alaskan form by having slightly longer mucro with distinctly angulare lat-



Figs. 105–117. — 105–106. *Hypogastrura tooliki* n.sp. — 105. Tip of right T.1. — 106. Left PAO. — 107–115. - *Hypogastrura trybomi*. Siberian syntypes. — 107. Central part of Th.2. — 108. Abd.3–6. — 109. Anal spine. — 110. Maxilla, inner side. — 111. Tip of tibiotarsus. — 112. Right PAO. — 113. Left & right PAO, another specimen. — 114. Dens & mucro, dorsal. — 115. Mucro, lateral (right) and oblique dorsal (left). – 116–117. *Hypogastrura* sp. near *trybomi* from Barrow. — 116. Mucro, oblique dorsal (left), dorsal (left) and lateral (right). — 117. Dens & mucro.

eral lamella (roundish in Alaskan form) and no clear subapical "shelf". Tibiotarsal tenent hair is distinctly stronger. An important similarity is the increased number of setae on ventral tube (up to 10+10 in the Norwegian specimens).

In view of the systematic confusion in this group and the small material at hand, I prefer to treat the Alaskan form as an unspecified member of the *trybomi* group.

Distribution and ecology

No definite records outside the Siberian type locality (see above). The Alaskan specimens from Barrow and Smith River were collected in damp, arctic polygon tundra.

Subgenus *Ceratophysella* Börner, 1932

Type species: *Podura armata* Nicolet, 1842

Key

1. Abd.4 with p_1 longer than p_2 (Fig. 128) 2
– Abd.4 with p_1 shorter than p_2 (Fig. 141) 6
2. Mucro reduced (Fig. 130). p_4 sensillae on Th.2–3 long, hair-like. Maxilla as Fig. 127 ..... 20. *glancei*
– Mucro normal. p_4 sensillae on Th.2–3 long or short. If long, then maxilla different from Fig. 127 3
3. Th.2–3 with p_4 sensillae short (Fig. 128) ..... 18. *brevisensillata*
– Sensillae normal, hair-like 4
4. Tibiotarsal tenent hair clavate (Fig. 125) ..... 19. *pseudarmata*
– Tenent hair acuminate 5
5. Large, violet-black species with thick, coarse macrochaetae (Fig. 118) ..... 17. *longispina*
– Smaller, brownish species with finer hairs ..... 16. *armata*
6. Unguiculus with long apical filament (Fig. 136) ..... 21. *pecki*
– Unguiculus normal, not reaching beyond tip of unguis 7
7. Abd.4 normally with 3+3 microchaetae (a_1–m_1–p_1) along median line (Fig. 141) 8
– Abd.4 normally with only 2+2 microchaetae along median line (Figs. 155, 156) ..... 27. *czuckczorum*
8. Dens with 6 dorsal setae ..... 22. *succinea*
– Dens with 7 setae 9
9. Abd.5 with 3+3 a-setae between the p_5 macrochatae (Fig. 144) 10
– Abd.5 with 4+4 a-setae between p_5–p_5 (Fig. 143) 11
10. Abd.1–3 with a'_2 present. Abd.4 with p_3 present (Fig. 144) ..... 25. *brevis* complex
– Abd.1–3 without a'_2. Abd.4 without p_3 (Fig. 148) ..... 26. *isabellae* n.sp.
11. Generally paler, grayish species with some pigment also on ventral side of body. Abd.5 with p_1 macrochaetae wider separated, normally with 2+2 a-setae between their bases (Fig. 143) ..... 24. *denticulata*
– Dark species with contrasting, nearly white ventral side. Abd.5 with p_1 macrochaetae closer together, only 1+1 a-setae between their bases (Fig. 142) ..... 23. *palustris*

16. **Hypogastrura (Ceratophysella) armata** (Nicolet)

Fig. 126

Podura armata Nicolet, 1842:57.

Description

In general morphology Alaskan specimens of *armata* are very similar to *brevisensillata* (see below), though the populations appear to be constantly short-haired with moderate differentiation of macro/microchaetae. Specimens having both p_2 and p_3 present on Abd.4 are frequent. Antennal file well developed, with 20–30 short, modified file setae. Maxilla (Fig. 126) has simple lam.5, without prolonged denticulate part.

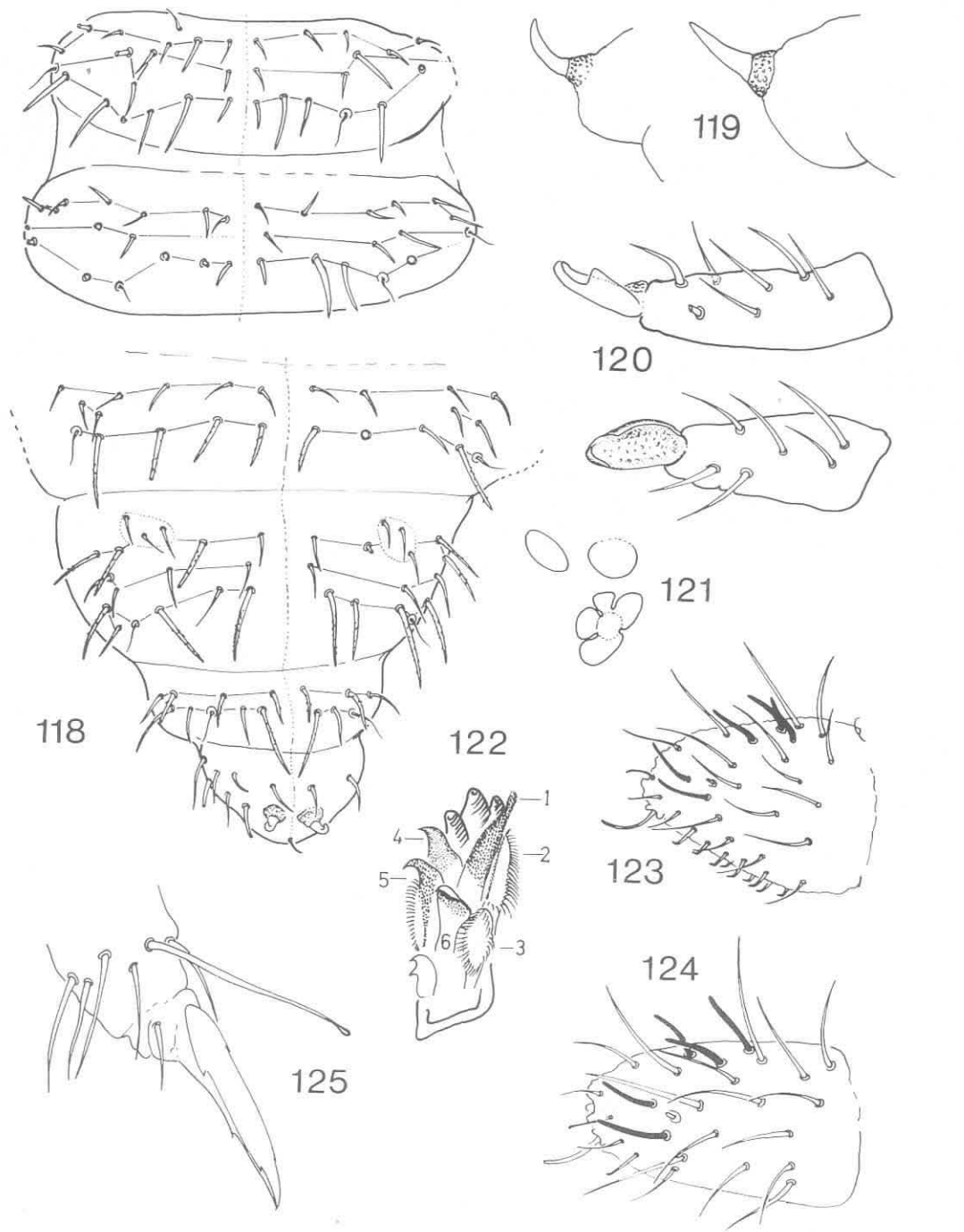
Discussion

Christiansen & Bellinger (1980) questioned the presence of true *armata* in North America. I have compared specimens from Alaska and NE Siberia (Chaun Bay) with material from Switzerland and France and find no sharp differences except in one important detail: European specimens have only one sublobal hair on maxillary outer lobe, whereas Alaskan/Siberian specimens have two like most other *Ceratophysella* with B chaetotaxy. Fjellberg (1984b) suggested a connection between the reduced number of sublobal hairs and a general morphogenetic instability of European *armata*. More work is needed to clear up these relations.

Reproductive specimens from Alaska have reduced mucro, an epitokous condition also described from European populations (Bourgeois 1974).

Distribution and ecology

North Slope (Icy Cape), *Central* (Fairbanks area, many records, Kanuti River, Mastodon Dome). Collected from tundra polygons, litter of willow, dwarf birch and alder growing in bogs and



Figs. 118–125. — 118–122. *Hypogastrura longispina*. — 118. Chaetotaxy of Th.2–3 & Abd.3–6 of syntype. — 119. Anal spine of syntype (left) and Barrow specimen (right). — 120. Dens & mucro of syntype. Lateral, dorsal. — 121. Right PAO. — 122. Maxilla. — 123. *Hypogastrura brevisensillata*. Left Ant.4, lateral. — 124–125. *Hypogastrura pseudarmata*. — 124. Left Ant.4, lateral. — 125. Tip of tibiotarsus with clavate tenent hair.

other damp places. Probably the species prefers wetter habitats than *brevisensillata*. – *Total distribution:* Holarctic.

17. **Hypogastrura (Ceratophysella) longispina** (Tullberg)

Figs. 118–122.

Achorutes longispinus Tullberg, 1876:37.
Hypogastrura hirsuta Valpas, 1967:32, syn.nov.
Ceratophysella arctica Martynova et al., 1973:79, syn.nov.

Type-material: The following description is based on recent specimens from Alaska and Spitsbergen and two syntypes from "Jenisejexpeditionen 1875. Achorutes longispinus T-g. T. Tullberg." and "Ry. sommar station. Chabarows. Now. S.eljo. 1/8.75. 13j" (last label with unclear pencil writing) which are present in Naturhistoriska Riksmuseet, Stockholm.

Description

Colour dark blue to bluish-black.

Size 1.6 mm.

Head. Ant.4 with weakly lobed apical bulb and 10–15 ventroapical file setae. Labrum with 5–5–4 undifferentiated hairs and 4 weak apical lobes. Maxilla as Fig. 122, lam.5 simple. Max.o.l. with 2 sublobal hairs. PAO with 4 lobes, slightly larger than an eye (Fig. 121).

Body granulation fine, slightly enlarged on Abd.5–6. Large specimens with conspicuous thick, blunt macrochaetae which are strongly serrate/ciliate. Chaetotaxy as Fig. 118. On Th.2 seta a_2 is enlarged. On Abd.1–3 p_1 becomes progressively longer, on Abd.3 much longer and thicker than a_1. Abd.4 with p_1 longer than p_2. Tenent hair acuminate, about as long as inner unguis. Unguis with distinct inner tooth and 2 pairs of lateral teeth. Unguiculus broadly lamellate, reaching middle of inner unguis. Ventral tube with 4+4 setae. Tenaculum with 4+4 teeth. Dens with 7 dorsal setae and often 1 additional seta on outer side near apex. Inner 2 apical setae slightly thickened at base. Mucro with angular lateral lamella. Apex not clearly dilated (Fig. 120). Anal spines rather short and thick, about 2/3 as long as inner edge of unguis 3, more or less curved (Fig. 119).

Discussion

Principally the species has the same chaetotaxy as *armata*. It is distinguished by larger size, darker longer and more curved (Fig. 119). The types of *hirsuta* were not seen, but numerous specimens from Spitsbergen (type locality) are without doubt the same species as Valpas described. Martynova et al. (1973) described *arctica* from Taimyr, Wrangel Island and Chukotka. Their description and figures are fully applicable to *longispina*.

Distribution and ecology

Only found in N. Alaska (Prudhoe Bay, Franklin Bluffs, Barrow, Kotzebue) in moss and litter in wet tundra. – *Total distribution:* Northern Holarctic.

18. **Hypogastrura (Ceratophysella) brevisensillata** (Yosii)

Figs. 123, 127, 128.

Hypogastrura pseudarmata Yosii, 1960:261, nec Folsom, 1916:490.
Ceratophysella brevisensillata Yosii, 1961:251.

Description

Colour. Variable from pale yellowish-brown, blue gray to nearly black.

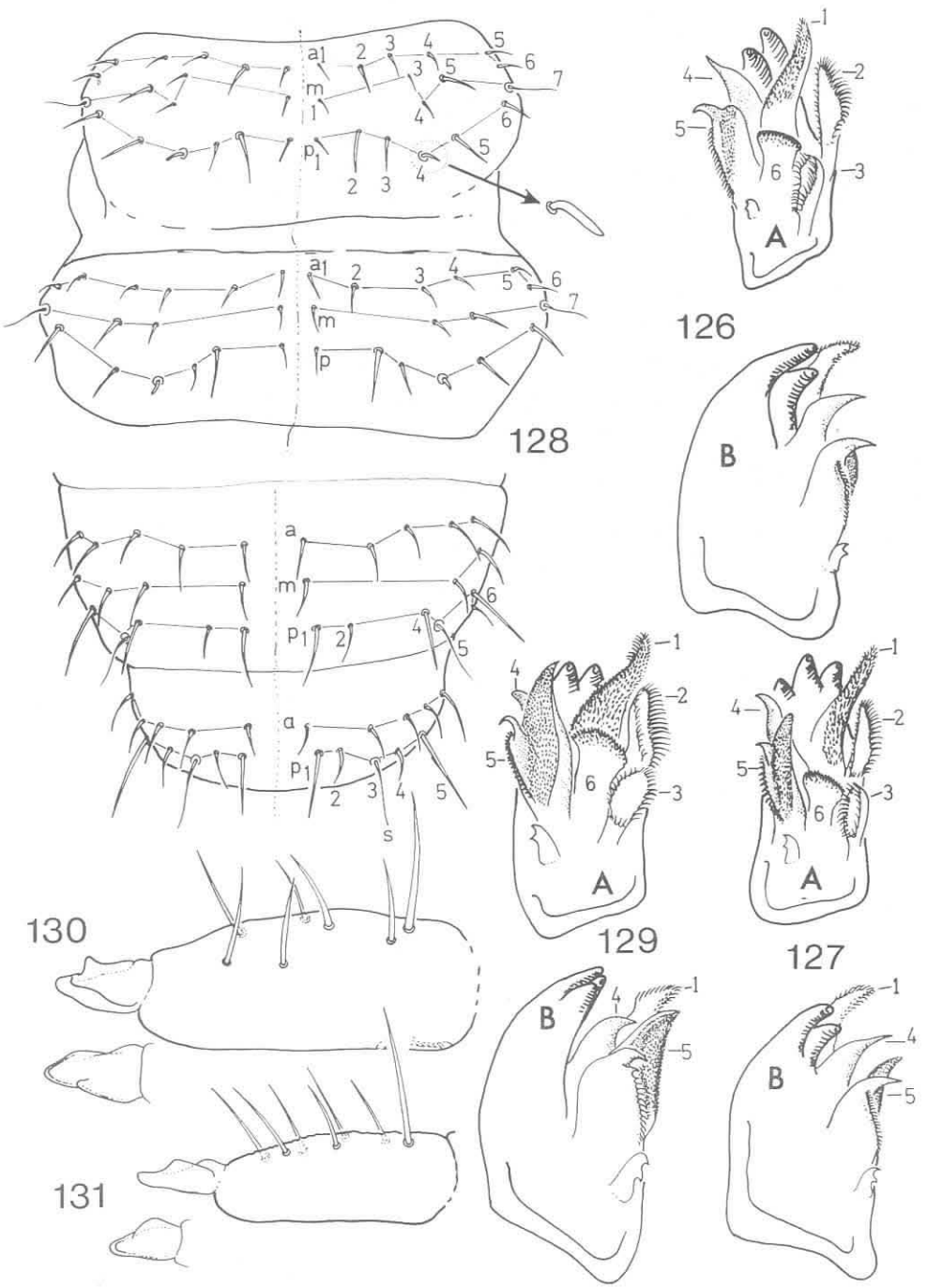
Size. 1.3 mm.

Head. Ventroapical file of Ant.4 variable, usually more than 15 modified file setae (Fig. 123). Maxilla characteristic (Fig. 127). The denticulate part of lam.5 prolonged, nearly reaching tip of lam.4.

Body. Body granulation fine and uniform. Chaetotaxy as Fig. 128. Sensilla p_4 on Th.2–3 small, spine-like, shorter than p_3. Also on Abd.1 the sensilla p_5 is usually small. Abd.4 with p_3 generally absent. Anal spines variable from slightly shorter than inner unguis 3, to 1.5 as long.

Discussion

The maxilla and shortened p_4 sensillae on Th.2–3 make this species easy to identify. However, the exact chaetotaxy and differentiation in macro/microchaetae is rather variable. The figured specimen (Fig. 128) is a short-haired one. Often the macrochaetae are more strongly developed. Such specimens have the p_1 on Abd.4 much longer than distance between their bases. Some of these variations are apparently population differences. Specimens from high alpine localities in Brooks



Figs. 126–131. — 126. *Hypogastrura armata*. Maxilla, inner side (A) and dorsal side (B). — 127–128. *Hypogastrura brevisensillata*. — 127. Maxilla. Inner side (A), dorsal side (B). — 128. Chaetotaxy of Th.2–3 & Abd.4–5. — 129. *Hypogastrura pseudarmata*. Maxilla. Inner side (A), dorsal side (B). — 130–131. *Hypogastrura glancei*. — 130. Dens & mucro of syntype. — 131. Dens & mucro of Alaskan specimen.

colour and the heavy, spine-like, rough macrochaetae. The orginal type specimens match very well with recent specimens from Alaska and Spitsbergen, though the anal spines are slightly Range are all very dark and frequently have long, hair-like p_5 sensilla on Abd.1.

Distribution and ecology

Probably widespread all over Alaska. *North Slope* (Barrow, Meade River, Sagwon Upland, Toolik Lake), *Brooks Range* (Galbraith Lake, mts. W of Atigun Camp, Dietrich Pass), *Central* (Prospect Camp, Bonanza Creek, Fairbanks area (many records), Mastodon Dome), *Alaska Range* (Talkeetna Mts., several places along Denali Hwy., Mt. McKinley Park). The species is a notorious visitor in fresh mushrooms in the fall, eating spores. Handfulls of specimens may be collected by knocking the hats of *Boletus, Russula, Lactarius,* etc. Otherwise it is generally present in forest litter in the central taiga (both hardwood and conifers), in litter of willow and dwarf shrubs on the arctic tundra, in alpine meadows, etc. Highest record 5.800 ft. (Brooks Range). – *Total distribution:* Nearctic – E. Palaearctic (Chukotka: Aborigen, Chaun Bay.

19. **Hypogastrura (Ceratophysella) pseudarmata** (Folsom)

Figs. 124, 125, 129.

Achorutes pseudarmatus Folsom, 1916:490

Description

Colour paler or darker purple brown. *Size* 1.3 mm. *Head.* Ant.4 with only 10–15 slightly modified file setae (Fig. 124). Denticulate part of maxillary lam.5 strongly prolonged, passing tip of lam.4 (Fig. 129). Maxillary outer lobe with 2 sublobal hairs. Tibiotarsal tenent hair long, clavate (Fig. 125). Large specimens with strongly serrate macrochaetae.

Discussion

The characteristic maxilla and presence of clavate tenent hairs easily identify this species. Also Ant.4 is more slender with weaker file than in the related species *armata* and *brevisensillata*.

Distribution and ecology

Only found once in litter and sandy humus in low *Salix* shrubs on fairly dry river bluffs at Atkasuk, Meade River (North Slope). – *Total distribution*: Nearctic – E. Palaerctic (Chukotka: Aborigen).

20. **Hypogastrura (Ceratophysella) glancei** (Hammer)

Figs. 130–135.

Ceratophysella glancei Hammer, 1953:18

Description

Colour. Dark bluish or brownish gray.

Size 0.8 mm.

Head. Ant.4 with a simple, protruding apical bulb (Fig. 134). Ventroapical field with less than 10 modified file setae. Ventral sac of Ant.3–4 weakly developed. Maxilla as in *brevisensillata* (Fig. 127).

Body. Chaetotaxy of the *armata* type. Body granulation fine, uniform. Anal spines short, 1/2–2/3 of inner unguis 3. Dens 2.8–3.5 as long as mucro, with 7 dorsal setae, all slender. Mucro blunt-tipped with a rather weak lateral lamella (Figs. 130–131). Mucro has an ecomorphic appearance, but there is no other indication that the specimens are ecomorphic or epitokous.

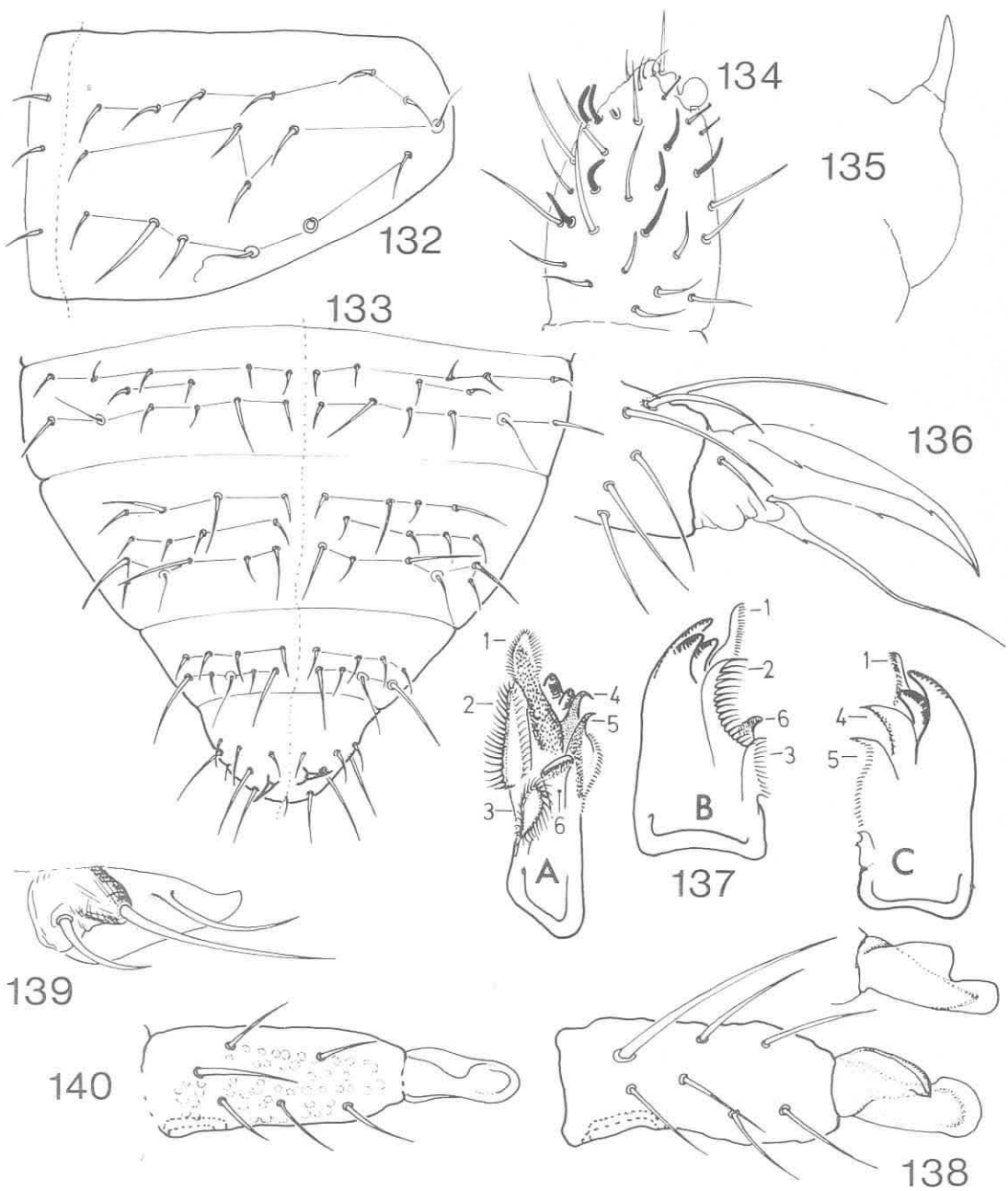
Discussion

A slide with 4 syntypes labelled "Type. Collembola. Canada 1948. Coppermine 205. Ceratophysella glancei n.sp. M. Hammer" is kept at Biosystematics Research Institute, Ottawa. Two of the specimens are in good condition and do not differ from the Alaskan specimens as far as could be seen (chaetotaxy of Th.2 and Abd.3–6, furca, anal spines, claws, antennae, maxillary outer lobe).

The species is related to the *armata* group, having the same maxilla as *brevisensillata*. However, it has normal, slender sensillae on thorax, a more slender Ant.4 with weak file and a shorter mucro.

Distribution and ecology

Several specimens were found in a lush, fairly dry meadow in upland tundra (3,700 ft) at Denali



Figs. 132–140. — 132–135. *Hypogastrura glancei*. — 132. Chaetotaxy of Th.2, right side (syntype). — 133. Chaetotaxy of Abd.3–6 (syntype). — 134. Left Ant.4, dorsal. — 135. Anal spine. — 136–139. *Hypogastrura pecki*. — 136. Tip of tibiotarsus. — 137. Right maxilla. Inner side (A), ventral (B), dorsal (C). — 138. Dens & mucro, dorsal. Above: Mucro, lateral. — 139. Right maxillary outer lobe. — 140. *Hypogastrura succinea*. Dens & mucro.

Hwy. 14 mi from Paxon. – *Total distribution:* Nearctic.

21. **Hypogastrura (Ceratophysella) pecki** Christiansen & Bellinger

Figs. 136–139, 141.

Hypogastrura pecki Christiansen & Bellinger, 1980:163.

Discussion

The Alaskan specimens differ somewhat from the orginal description which was based on material from New York and Idaho: The long basal hair on dens is slightly shorter (0.8–0.9) than dens, in type specimens slightly longer than dens. Ant.4 has a ventral file of 15–20 slightly modified setae, not mentioned in the original description. Maxilla (Fig. 137) is of the general *denticulata* type. Maxillary outer lobe has 1 sublobal hair. One reproductive female from Fairbanks is clearly epitokous, having reduced length of anal spines and mucro.

The extremely long filament on unguiculus (Fig. 136) separates this species from other Nearctic *Ceratophysella*.

Distribution and ecology

Appears to be widespread in the Bering area and the Aleutians (Cape Krusenstern, Nunivak Isl., Chowiet Isl., Homer. Aleutian Isls.: Buldir, Adak, Akun). Also found inland at Fairbanks. The species was collected from grass meadows, *Salix/Carex* litter in bogs, vegetation from edge of lagoon, grass compost, *Populus balsamifera* litter, etc. Specimens from the southern states have been collected in caves. – *Total distribution*: Nearctic.

22. **Hypogastrura (Ceratophysella) succinea** Gisin

Fig. 140.

Hypogastrura succinea Gisin, 1949:393.

Description

Colour brownish, rather dark.

Size 1.5 mm.

Head. Ant.4 with simple apical bulb and 5–6 blunt sensorial setae (2 lateral near apex, 3–4 dorsal). Maxilla of *denticulata* type (Fig. 137). Outer lobe with 1 sublobal hair. Abd.4 with a_1–m_1 in two rows that often diverge only moderately. Dens with 6 dorsal setae (Fig. 140).

Distribution and ecology

Only found once at Fairbanks on the banks of Tanana River, in a thin layer of moss, *Equisetum* and *Carex* on mud. – *Total distribution:* Holarctic

Discussion

The presence of only 6 dorsal setae on dens separates this species from nearest relatives. I have compared Alaskan specimens with Norwegian material and find no difference.

Christiansen & Bellinger (1980) report the species *H. scotti* (Yosii) from Barrow. The original description of Yosii (1962) was based on two Californian specimens. Judging from his description and figures it is hardly possible to distinguish *scotti* from *succinea*.

23. **Hypogastrura (Ceratophysella) palustris** (Martynova)

Fig. 142

Ceratophysella palustris Martynova, 1978:27.

Description

Colour grayish-black, ventral side paler, almost white.

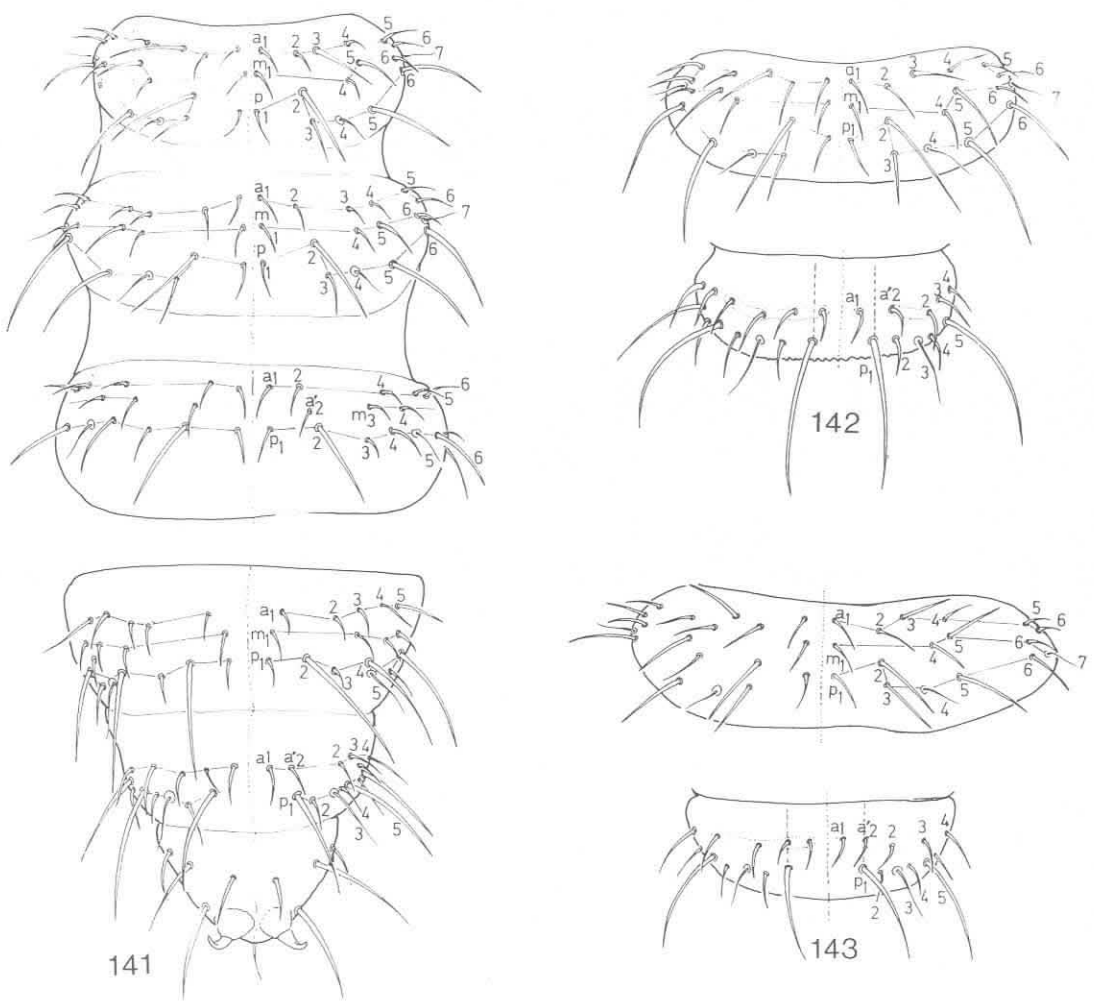
Size 1.8 mm.

Head. Ant.4 with at most 15 slightly modified file setae. Maxilla as in *pecki* (Fig. 137).

Body granulation strong. Macrochaetae unusually long, on Th.2 the macrochaeta p_2 about 2× as long as p_3 and a_3 (Fig. 142). On Abd.5 the p_1 macrochaetae are set rather close together, clearly inside a'_2. Distance between their bases 0.4–0.6 as long as distance between the p_1 on Abd.4. Number of granules between p_1–p_1 on Abd.5 usually 8–11 in adults.

Discussion

The species is very similar to *denticulata*. In mixed samples of the two species, *palustris* is recognized by the nearly white ventral side, contrast-



Figs. 141–143. — 141. *Hypogastrura pecki*. Chaetotaxy of Th.2 – Abd.1 & Abd.4–6. — 142. *Hypogastrura palustris*. Chaetotaxy of Th.2 & Abd.5 — 143. *Hypogastrura denticulata*. Chaetotaxy of Th.2 & Abd.5.

ing with the dark dorsal side. Also the macrochaetae are stronger with the p_1 pair on Abd.5 set closer together (Figs. 142, 143). Antennal file is usually more strongly developed in *denticulata*.

Distribution and ecology

Common in wet tundra in N. Alaska (Kotzebue, Cape Krusenstern, Cape Thompson, Barrow, Meade River, Franklin Bluffs, Toolik Lake, Canning River Delta). Only few records S of Brooks Range (Kanuti River, Mastodon Dome). – *Total distribution:* Nearctic – E. Palaearctic (Indigirko, Chaun Bay, Anadyr).

24. **Hypogastrura (Ceratophysella) denticulata** (Bagnall)

Figs. 143, 147.

Achorutes denticulatus Bagnall, 1941:218.

Description

Colour grayish-blue to brownish-black, rather

spotted. Ventral side paler but always with some pigment.

Size, 1.8 mm.

Head. Ant.4 with at most 15 slightly modified file setae. PAO with anterior lobes much longer than posterior (Fig. 147). Maxilla as in *pecki* (Fig. 137). Maxillary outer lobe with 1 sublobal hair. Th.2 with p_2 much less than 2× as long as p_3 and a_3 (Fig. 143). Abd.5 with 10–15 granules between bases of p_1. Distance between their bases 0.6–0.8 as long as distance p_1–p_1 on Abd.4. Between macrochaetae p_5 on Abd.5 there are 4+4 setae of the a-row. Macrochaeta p_1 at level with or slightly outside a'_2. Tibiotarsal tenent hair acuminate.

Discussion

On a world scale, this is a most problematic species. The crucial point in the definition above is the presence of 4+4 a-setae inside the two p_5 macrochaetae on Abd.5 (in species with only 3+3 the a'_2 is absent, cf. Fig. 144). European populations are known to vary between 3+3 and 4+4 (Cassagnau 1972). Apart from apparent anomaly, such variation is not seen in Alaskan samples. Christiansen & Bellinger (1980) used presence or absence of antennal file for splitting their material into resonable taxa. There are no sharp distinctions in the Alaskan samples. The file is always present, more or less developed.

In Alaska the species could only be confused with *palustris* which has the same rough skin granulations and a'_2 present on Abd.5. For separation, see that species.

Distribution and ecology

Probably distributed over most of Alaska, but no records from the northern arctic coast or from high alpine sites. *North Slope* (Meade River, Sagwon Upland, Franklin Bluffs, Toolik Lake), *Brooks Range* (Galbraith Lake, "Last Spruce" S of Chandalar), *Bering Area* (Cape Krusenstern), *Central* (Fairbanks area – many records, Mastodon Dome, Eagle Summit), *Alaska Range* (Denali Hwy. near Amphitheatre Mts,. Richardson Hwy. at mi.235). The species occurs in forest litter in the central taiga and in meadows and shrub litter (*Salix, Betula*, etc.) in the arctic/alpine tundra. Most records are from moderately dry sites, a few also from bogs and wet meadows. – *Total distribution:* Holarctic – Cosmopolitan.

25. **Hypogastrura (Ceratophysella)** cf. **brevis** Christiansen & Bellinger

Figs. 144–146.

Hypogastrura brevis Christiansen & Bellinger, 1980:155

Description

From many wet sites in N. Alaska, mainly N of Brooks Range, I have a large material of a small (mature at 0.9–1.0 mm), dark violet black (also ventral) species that cannot be identified with certainty. It differs from *denticulata/palustris* by absence of a'_2 on Abd.5, finer and more uniform body granulation, less developed macrochaetae and only slightly diverging rows of p_1–m_1–a_1 on Abd.4 (Fig. 144). The Ant.4 file is always very weak. PAO variable, but anterior lobes not much larger than posterior. Tibiotarsal tenent hair usually acuminate, but sometimes truncate or faintly clavate. The 7 dorsal setae on dens all slender. Number of granules along a line between bases of p_1 on Abd.5 variable from 11–18, usually 13 or 14. Two forms are seen in this complex:

a. Body hairs rather fine, thin. Th.2–3 without m_6 in the lateral group (Fig. 144). Abd.1–3 without m_3 and m_4, or rarely one of them present.

b. Slightly larger form with thicker, coarser body hairs. Th.2–3 usually with m_6 present, Abd.1–3 usually with m_3 and m_4 present (Fig. 145). This second form is also seen from Chaun Bay.

A single sample from a snow-edge pond in the Juneau mountains (3,200 ft) has very large individuals (2.0 mm) with number of granules between p_1 on Abd.5 varying from 14–22.

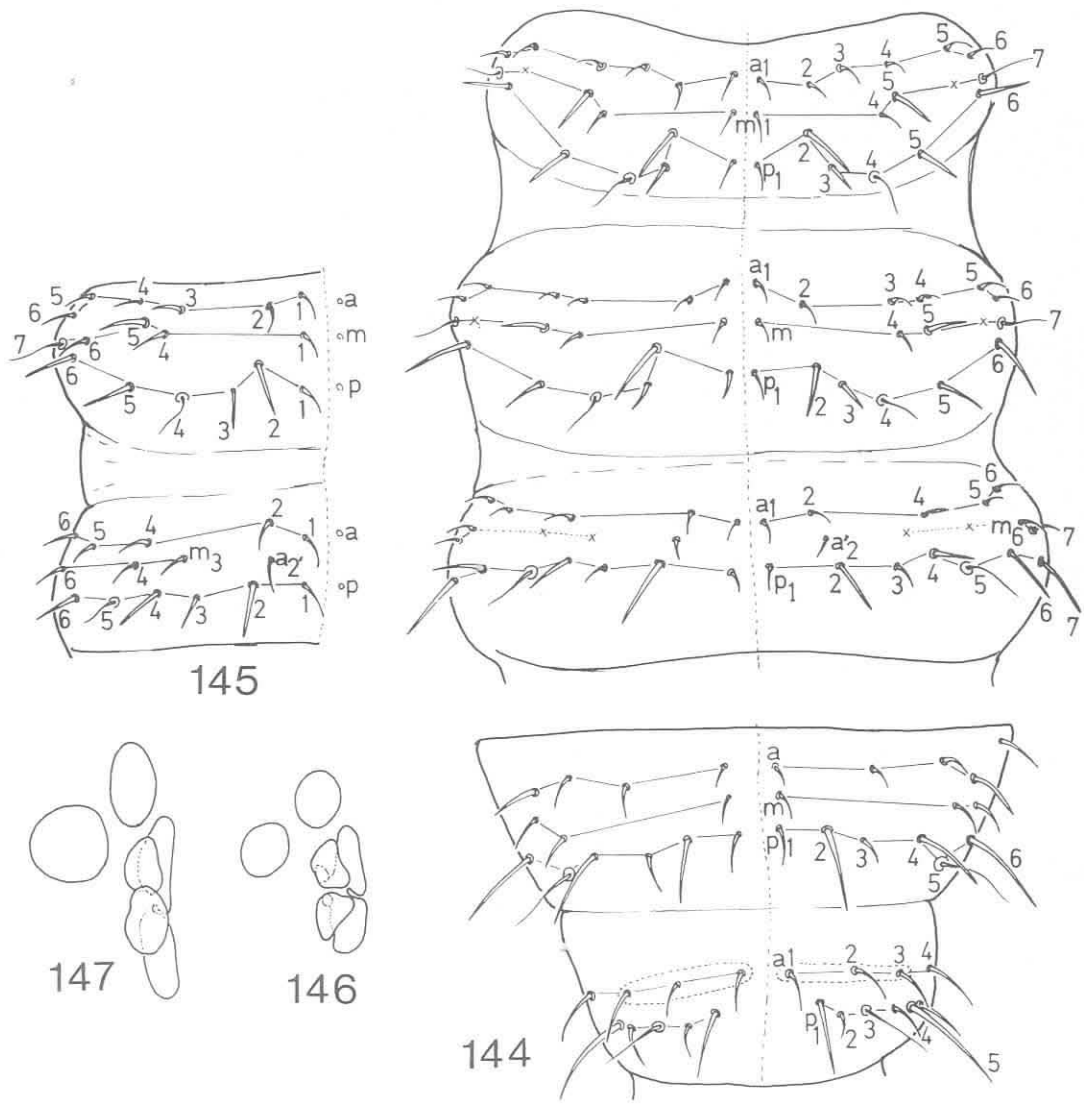
Discussion

These forms belong to a complex with several Nearctic forms/species, both described and undescribed, which are all poorly known and distinguished by rather small and dubious characters (shape of PAO, apical Ant. bulb, tibiotarsal tenent hair, setae on dens, Abd.5 granules, etc.). Much more work is necessary before a successful taxonomic revision can be made.

26. **Hypogastrura (Ceratophysella) isabellae** n.sp.

Figs. 148–151.

Type locality: Alaska. Alaska Range, E of Richardson



Figs. 144–147. — 144–146. *Hypogastrura brevis*. — 144. Chaetotaxy of Th.2–Abd.1 & Abd.4–5 of form A. — 145. Chaetotaxy of Th.3–Abd.1, left side, form B. — 146. Right PAO. — 147. *Hypogastrura denticulata*. Right PAO.

Hwy, Triangle Peak between Castner Glacier and Canwell Glacier, 6,600 ft.
Type material: Holotype: One specimen (alc.) from "Alaska. Alaska Range. Triangle Peak, 9.VIII.1980. Moss & lichens at snow edge, 6,600 ft. A.Fjellberg leg.", at USNM. – *Paratypes:* 73 (alc.) as above, at USNM. 20 (alc.) as above, at BM. 18 (slides) as above, at AF. 89 (alc.) and 9 (slides) as above except "Moss on rocks with droppings from birds and Dall Mt. sheep, 6,300 ft.", at MCZ. 28 (alc.) and 6 (slide) as above except "Moss on gravel at snow edge, 6,300 ft.", at USNM. 22 (alc.) and 4 (slides) from "Alaska. Brooks Range. Dietrich Pass. 20.VIII.1976. Wet moss, lichens, grass, etc. in stones in high alpine brook. A.Fjellberg leg.", at USNM. 10 (slide) as above, in AF.
Derivation of the name: After Isabell Pass near the type locality.

Description

Colour. All black, also ventral side. Smaller specimens violet black.

Size 1.6 mm.

Head. Ant.4 apical bulb simple or slightly lobed. Ventral file weak, with 10–15 modified setae. Ant.4 with 6–7 blunt sensorial setae. Ant.3 organ normal. Ant.3–4 ventral sac present. Ant.4 slightly shorter than Ant.3. Head with 8+8 ocelli. PAO with 4 lobes, anterior pair slightly enlarged (Fig. 151). Sometimes lobes rather irregular, or one missing. Maxilla of general *denticulata* type (Fig. 137). Lam.1 slightly shorter than maxillary teeth. Maxillary outer lobe with 1 sublobal hair.

Body. Body granulation fine and nearly uniform, slightly enlarged on last 3 abdominal segments. Abd.5 with 13–20 granules between p_1. Body hairs finely serrate/ciliate. Macrochaetae strongly developed, microchaetae short and thin. Chaetotaxy as Fig. 148. Head normal. Th.1 with 1+1, 2+2 or 3+3 setae. In extreme cases only the lateral pair is kept. On Th.2–3 the setae a_4, m_4 and m_6 may be present or absent. On Abd.1–3 the short seta a'_2 is always absent, p_3 absent or present. Macrochaetae p_4 become progressively longer on Abd.1–4. Abd.1–3 with reduced m-row, only the lateral m_6 present. Abd.4 without p_3, setae a_3, a_4 and a_5 enlarged. Of the m-row, only the lateral m_5 present (rarely both m_4 and m_5). Abd.5 without a'_2. The microchaetae p_2 and p_4 sometimes absent. Anal spines slightly curved, about 2/3 as long as inner edge of unguis 3. Unguis with distinct inner tooth and 2 pairs of lateral teeth. Unguiculus broadly lamellate, about 1/2 of inner unguis. Tenent hair acuminate. Ventral tube with 4+4 setae. Tenaculum with 4+4 teeth. Furca strong, dens with 7 dorsal setae, all slender. Mucro normal with spoon-shaped apex (Fig. 149).

Discussion

This dark characteristic species is readily identified by the reduced chaetotaxy, notably the absence of a'_2 on Abd.1–3 and absence of p_3 on Abd.4. The Alaskan material shows an interesting variation. In the Alaska Range population the median pair of seta on Th.1 is usually absent and p_3 on Abd.1–3 is nearly always absent. In Brooks Range specimens the median pair on Th.1 is generally present and so are the p_3 on Abd.1–3. Also the granulation on Abd.4–6 is slightly stronger in Brooks Range specimens. These observations probably indicate a genetic difference in discrete subpopulations of the species.

H. isabellae is probably related to the Alaskan forms of the *brevis* complex described above. In particular the sample from the Juneau snowfields comes very close, apart from chaetotaxy. *H. isabellae* could well have developed from that stock by reduction of a'_2, p_3 and the m-row on Abd.1–4. The rather simple variation in chaetotaxy and the abundance of specimens in suitable habitats, should make future statistical analysis of the complex a promising field.

Distribution and ecology

Only found in high alpine snow-edge communities in Alaska Range and Brooks Range (see type material). – *Total distribution*: Nearctic – E. Palaearctic (a single specimens is seen from mountains at Aborigen N of Magadan).

27. **Hypogastrura (Ceratophysella)** cf. **czukczorum** (Martynova & Bondarenko)

Figs. 152–156.

Ceratophysella czukczorum Martynova & Bonarenko, 1978:48.

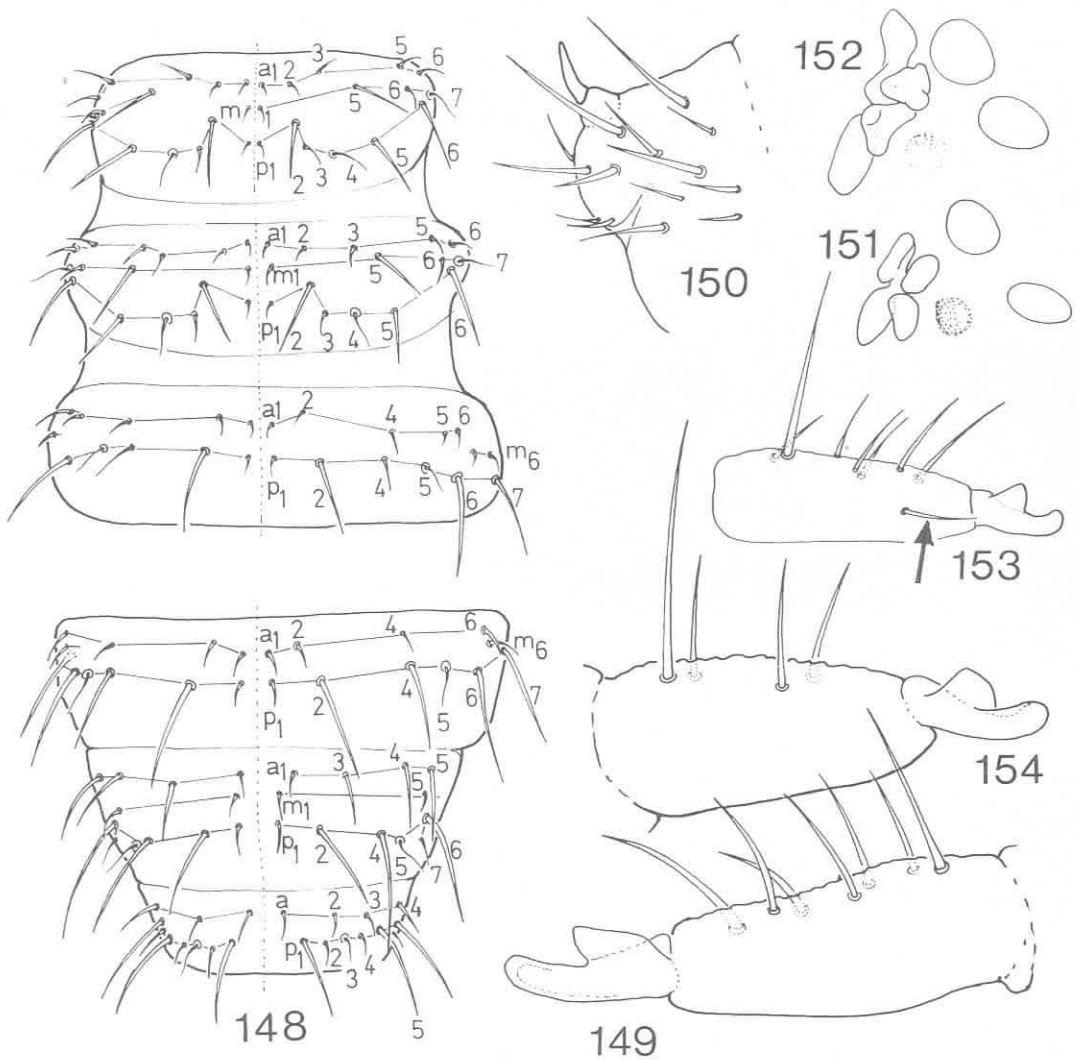
Description

Colour. Pale spotted bluish-gray.

Size 1.2 mm.

Head. Ant.4 with simple apical bulb and 7 curved, blunt sensorial setae. Ventroapical file weak, only 10–15 modified setae. Head with 8+8 ocelli. PAO with 4 rather variable lobes, anterior pair usually much larger than posterior. Maxilla of the *denticulata* type (Fig. 137). Maxillary outer lobe with 1 sublobal hair.

Body. Granulation rather fine, distinctly coarser on last abdominal segments. Abd.5 with 10–12 granules between p_1 setae. Body hairs smooth or finely ciliate, well differentiated in micro/macrochaetae. Chaetotaxy as Figs. 155, 156. On Th.2–3 m_4 and m_6 rarely absent. Abd.1–3 with a'_2 present, a_4 may be absent. Abd.4 with only 2+2 microchaetae along median line, m_1 absent (a few specimens with m_1 present on one side are seen). In the a-row, there are always 4+4 setae inside the macrochaetae p_6. Microchaeta p_3 present. Abd.5 with 3+3 a-setae inside p_5 (a'_2 absent), p_2 and p_4 present. Anal spines rather thin, about 1.3 as long as inner edge of unguis 3. Claws with distinct teeth. Empodium lamellate. Tenent hair acuminate. Ventral tube with 4+4 setae. Tenaculum with

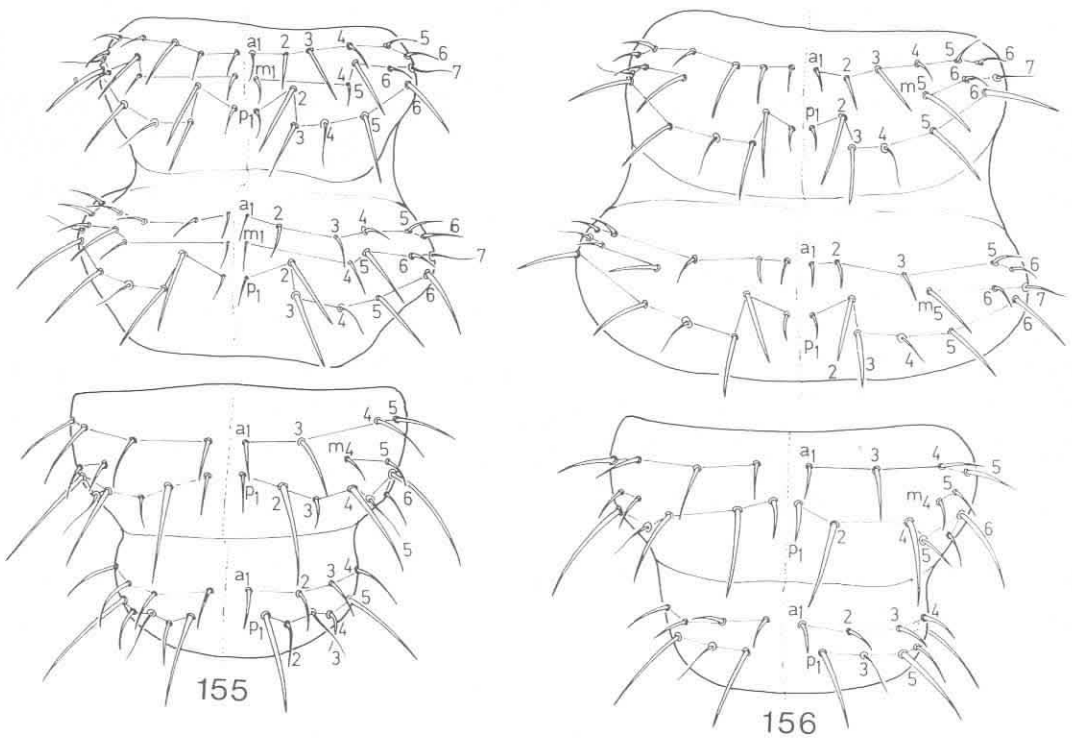


Figs. 148–154. — 148–151. *Hypogastrura isabellae* n.sp. — 148. Chaetotaxy of Th.2–Abd.1 & Abd.3–5. — 149. Right dens & mucro, lateral. — 150. Abd.6, lateral. — 151. Left PAO. — 152–154. *Hypogastrura* cf. *czukczorum*. — 152. Left PAO. — 153. Left dens & mucro, form C. Arrow: Extra seta. — 154. Left dens & mucro, main form.

4+4 teeth. Dens and mucro as Fig. 153, 154. Dens normally with only 4 setae (3–5), all slender. Reproductive specimens are epitokous with reduced mucro.

Discussion

The most characteristic features of this species are the pale colour, absence of m_1 on Abd.4 and low number of setae on dens. The above description is based upon various samples from N. Alaska and deviates slightly from the original description of three specimens from Anadyr, NE Siberia. Most significant is the absence of a'_2 on Abd.1–3 in the type specimens. But as even this seta is variable in certain *Ceratophysella* species (e.g. *norensis* Cassagnau, 1956), I seen no reason to separte the Anadyr and Alaskan forms taxonomically.



Figs. 155–156. *Hypogastrura* cf. *czukczorum*. — 155. Chaetotaxy of Th.2–3 & Abd.4–5, main form. — 156. Ditto, form C.

In Alaska there are also some other forms with only 2+2 median microchaetae on Abd.4 (m_1 absent):

a. In some of the north coast samples (Barrow, Icy Cape) a constantly darker form is present together with *czukczorum*. It lacks the a'_2 on Abd.1–3, Th.2–3 without m_4 and m_6 and dens with 7 setae. The general appearance of the two forms is the same.

b. From Buldir, Aleutian Isls., I have a sample of a dark form in which m_1 on Th.2–3 is frequently absent (thus only 2+2 microchaetae along median line), m_4 is absent but m_6 usually present. Abd.1–3 without a'_2, Abd.5 usually without p_4. Dens with 3–6 setae, usually 5. Whole body notably coarser granulated than previous forms.

c. From several N. Slope localities I have a fairly dark form which always has Th.2–3 m_1 and m_4 absent (Fig. 156), a_4 sometimes absent and m_6 present. On Abd.1–3 a'_2 is absent, m_3 and p_3 sometimes absent. The absence of m_1 on Th.2–3 makes this form similar to the Buldir form descibed above, but it does not have the coarsely granulated integument. Moreover, it differs from all the above by a constant absence of p_3 on Abd.4 (Fig. 156). On Abd.5 p_2 and p_4 usually absent. Dens with 5–8 dorsal setae, usually 7. The body hairs, both micro- and macrochaetae, are much longer than in any of the above forms.

This characteristic form is also seen from Chaun Bay and was first considered to be a distinct species. However, I changed my mind when a sample from the mountains at Aborigen brought to light a number of specimens matching the above form apart from Th.2–3 having all a_1–m_1–p_1 present.

Thus the situation in this Beringian form complex is utterly confusing. It is not made simpler by Martynova's (1978) description of *Ceratophysella czelnokovi* from Wrangell Island (3 specimens), which appear to be similar to the main Alaska form, apart from dens which has 7 setae. In fact the main Alaska form takes an intermediary position with chaetotaxy like *czelnokovi* and furca like *czukczorum*.

Distribution and ecology

Generally found in damp places in arctic tundra in N. Alaska and the Bering area.

Main form: Barrow, Icy Cape, Prudhoe Bay, Meade River, Cape Krusenstern, Chevak, Nunivak Isl., Pribilof Isl.

a-form: Barrow, Icy Cape.

b-form: Buldir (Aleutian Isl.).

c-form: Prudhoe Bay, Sagwon Upland, Umiat, Meade River. – *Total distribution:* Nearctic – E. Palaearctic.

Subgenus *Cyclograna* Yosii, 1961

Type species: *Hypogastrura vulgaris* Yosii, 1960.

Yosii (1961) erected the genus *Cyclograna* for the species *Hypogastrura vulgaris*, separated from *Hypogastrura* s.str. and *Ceratophysella* by the peculiar posterior PAO lobes which partly surround the accessory tubercle. Later a number of species have been added to the group (Yosii 1962, 1977, Christiansen & Bellinger 1980) from Asia and N. America.

Examination of the Alaskan *Cyclograna*, including *vulgaris*, uncovered a primitive chaetotaxy of Th.2–3 having seta p_2 in posterior position at level with p_1. On Th.2 seta m_2 is present. Also the maxillary outer lobe appears primitive with 2 sublobal hairs. The same conditions were found in the rather odd *krafti* (Scott), currently held to be a *Ceratophysella* (Christiansen & Bellinger 1980), and in the related *wallmoi* n.sp. Consequently these two species are transfered to *Cyclograna*, even if their PAO is more of the *Ceratophysella* type. A redefinition of *Cyclograna* is necessary, stressing the importance of chaetotaxy above PAO shape. All *Cyclograna* species have an Abd.4 chaetotaxy of A-type (p_1 shorter than p_2), but differs from all *Ceratophysella* of A-type by having m_2 present on Th.2, seta p_2 of Th.2–3 in posterior position and 2 sublobal hairs on maxillary outer lobe.

Probably *wallmoi* and *krafti* belong to a plesimorphic branch of *Cyclograna*, with the other species in an apomorphic group characterised by the peculiar PAO and spine-like sensillae on Abd.2 (Fig. 170).

Several of the known *Cyclograna* species have thick spines on head (Fig. 167). Christiansen & Bellinger (1980) noted that individuals without spines might be found among spined ones. In most of the Alaskan species absence of cephalic spines appears to be correlated with reduced size of mucro. This may indicate that physiological phenomena like epitoky and ecomorphosis are involved, making the current systematics of the group rather vague.

Christiansen & Bellinger (1980) establish *Cyclograna* as a junior synonym of *Mitchellania* Wray, 1953. However, as chaetotaxy of the *Mitchellania* type species *hermosa* Wray is unknown, I prefere to use the name *Cyclograna* until it is verified that *hermosa* fits the new definition of the subgenus.

Key

1. Abd.2 with long, hair-like p_5 sensillae (Fig. 158). Posterior PAO lobes only partly curved around accessory boss (Figs. 160, 164) 2
– Abd.2 with short, spine-like sensillae (Fig. 170 D). Posterior PAO lobes wrapped around accessory boss 3
2. Ant.4 with strong ventral file (Fig. 165). Inner apical setae on dens thickened, angular (Fig. 163) ..... 28. *krafti*
– Ant.4 with weak file (Fig. 159). Dens with slender setae (Fig. 161) ..... 29. *wallmoi* n.sp.
3. Spines never present on head ..... 31. *vulgaris*
– Cephalic spines present (may be absent in some specimens of the population) 4
4. 3+3 cephalic spines (Fig. 167) ..... 30. *loricata*
– 2+2 cephalic spines 5
5. Anal spines very strong (Fig. 172). Body hairs long, thick, serrate. Lateral sensilla (m_7) on Th.2 spine-like (Fig. 173) ..... 32. *virga*
– Anal spines normal (Fig. 171). Body hairs shorter and finer. Lateral sensilla on Th.2 slender (Fig. 170 A) ..... 33. *horrida*

28. **Hypogastrura (Cyclograna) krafti** (Scott)

Figs. 158, 163–165.

Spinachorutes krafti Scott, 1962:238.

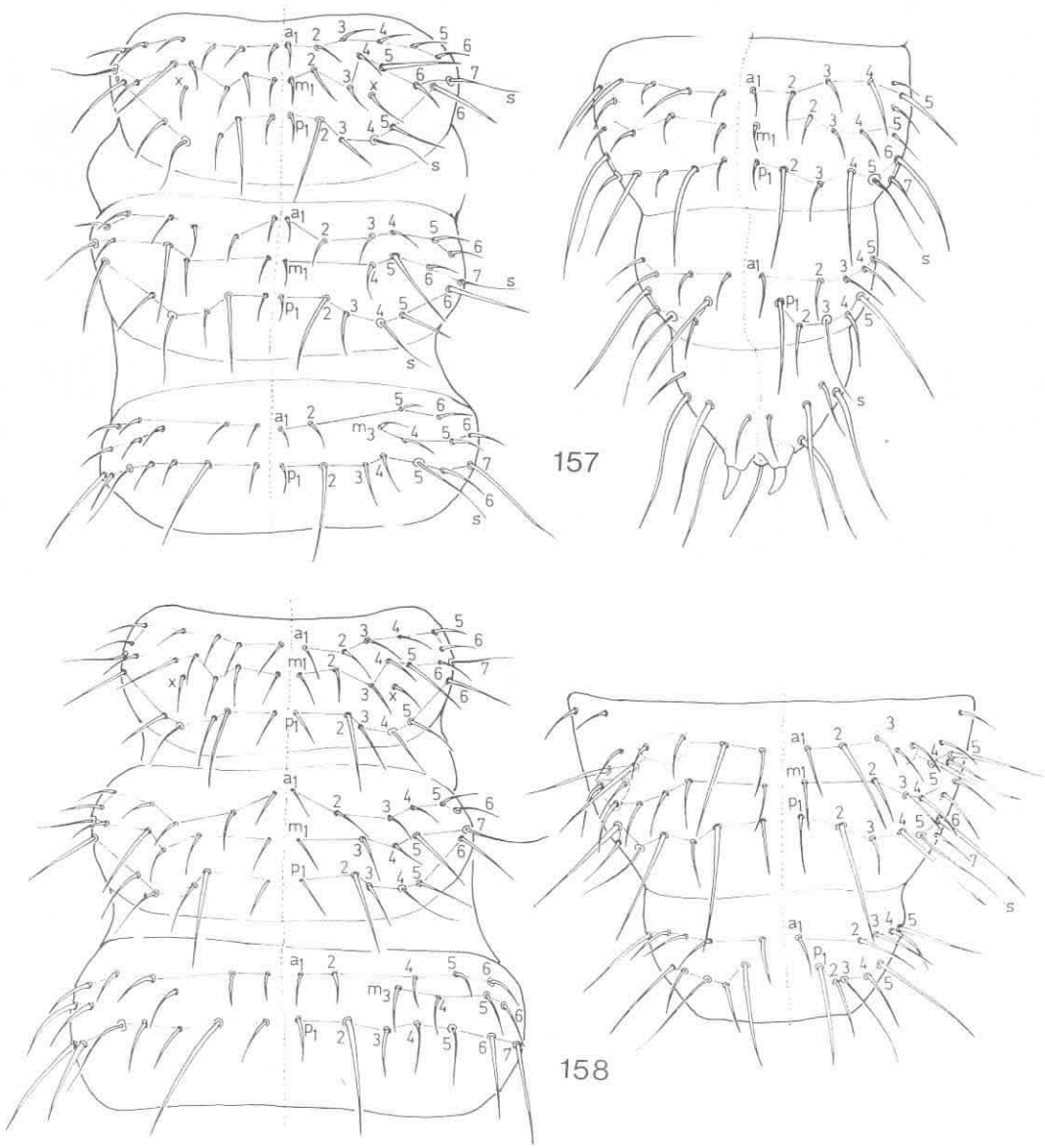
Description

Colour pale with spotted bluish-gray pigment.

Size 1.4 mm.

Head. Ant.4 with a very dense ventral file composed of many short, thick, flat-topped sensillae (Fig. 165). PAO as Fig. 164, with posterior lobes partly surrounding the accessory boss. Maxilla as in *wallmoi*, Fig. 162. Max.o.l. with 2 sublobal hairs.

Body granulation fine and uniform, with more than 20 granules between p_1 setae on Abd.5. Body



Figs. 157–158. — 157. *Hypogastrura wallmoi* n.sp. Chaetotaxy of Th.2–Abd.1 & Abd.4–6. — 158. *Hypogastrura krafti*. Chaetotaxy of Th.2–Abd.1 & Abd.4–5.

hairs long, smooth or weakly serrate. Chaetotaxy as Fig. 158, that of Th.2 and Abd.4 rather variable due to a moderate plurichaetosis. Characteristics are: Th.2 with m_2 present, Th.2–3 with p_2 in backward position, at level with p_1, Abd.1–3 without a'_2, Abd.4 with a_1–m_1–p_1 in nearly parallel rows. Abd.5 with p_1 macrochaetae moved forward to a m-position. Anal spines about as long as inner edge of unguis 3. Dens with 7 dorsal setae, the inner 2 apicals thickened, angular. Mucro well developed with broad apex. Dens about 1.7–2.2 as long as mucro (Fig. 163).

Discussion

The species superficially looks like a finely granulated *denticulata*, but the chaetotaxy and presence of two sublobal hairs readily separates it from that group. For separation from *wallmoi*, see below.

Distribution and ecology

Only found in SE Alaska near Juneau (Montana Creek Trail and mountain N of Mendenhall glacier, 3,300 ft) in forest litter (sitka spruce), mushroom, moss and lichens near snow edge, etc. – *Total distribution*: Nearctic.

29. **Hypogastrura (Cyclograna) wallmoi** n.sp.

Figs. 157, 159–162.

Type locality: Alaska. Juneau. Mountains between Mendenhall Glacier and Montana Creek Trail, 3,200 ft. *Type material: Holotype:* One male (alc.) from "Alaska. Juneau. 13.VII.1980. Moss on stone in melt water from snow fields, 3,200 ft. A.Fjellberg leg.", at USNM. – *Paratypes:* 9 (4 alc., 5 slide) as above, at BM. 25 (22 alc., 3 slide) as above, at USNM. 4 (slide) as above, at AF. *Derivation of name:* Named after Dr. Olof Charles Wallmo, Juneau, who organised my field work in SE Alaska.

Description

Colour spotted grayish-black. Ventral side paler.

Size 1.4 mm.

Head. Ant.4 with unlobed apical bulb. Ventral file poorly developed, with about 15 rather long, slender file setae (Fig. 159). Usually there are 7 blunt senorial setae. Ant.3 organ normal. Ant.1 with 7 setae. Head with 8+8 subequal ocelli. PAO with 4 lobes, anterior pair enlarged (Fig. 160). Maxilla as Fig. 162. Apex of lam.1 dilated, with fine marginal filaments. Max.o.l. with 2 sublobal hairs.

Body granulation fine and uniform. Abd.5 with more than 20 granules between bases of p_1. Macrochaetae smooth or weakly serrate. Chaetotaxy as Fig. 157. Supernumerary and asymmetric setae frequent due to a moderate plurichaetosis. Characteristics are: Th.1 with 3+3 setae, Th.2 with m_2 present, Th.2–3 with p_2 in backward position, a_3 not enlarged, Abd.1–3 without a'_2, Abd.4 with a_1–p_1–m_1 in parallel rows. Abd.5 with p_4 present. Ventral tube with 4+4 setae. Tenaculum with 4+4 teeth. Dens with 7 slender setae. The small inner apical seta sometimes absent. Mucro normal but rather small. Dens 2.3–3.0 as long as mucro (Fig. 161). Claws with weak teeth. Unguiculus lamellate, reaching middle of inner unguis. Tenent hair acuminate. Anal spines rather weak, slightly curved, a little shorter than inner edge of unguis 3.

Abd.5–6 prolonged, cylindrical, giving the species a very slim appearance.

Discussion

The new species is closely related to *krafti*, but differs by the weak antennal file and slender setae on dens. The short mucro suggests that *wallmoi* could be an epitokous form of *krafti*, but both species keep their specific characters both as juveniles and unreproductive adults. Reproductive specimens are not seen. There is no indication of ecomorphosis in the material. Bourgeois & Cassagnau (1972) set forth the idea that a reduction of Ant.4 file might be a response to cold environment in cave-adapted forms. The presence of *krafti* in the lowland forests and *wallmoi* in the mountain may support this idea.

Following the keys of Christiansen & Bellinger (1980), *wallmoi* will key out as *maheuxi* Butler. However, examination of the holotype of *maheuxi* (Lyman Entomological Museum, Canada) and a number of other specimens from the type series, revealed several striking differences: *maheuxi* has a 3-lobed Ant.4 apical bulb, maxillary outer lobe has only 1 sublobal hair, Th.2–3 has *denticulata* type chaetotaxy (m_2 absent, p_2 moved forward, a_3 enlarged), Abd.1–3 has a'_2 present, Abd.4 with a_1 setae much wider separated than m_1 and p_1 setae, Abd.5 with p_4 absent (Fig. 166). *H. maheuxi* probably has its closest relatives among the *denticulata* complex.

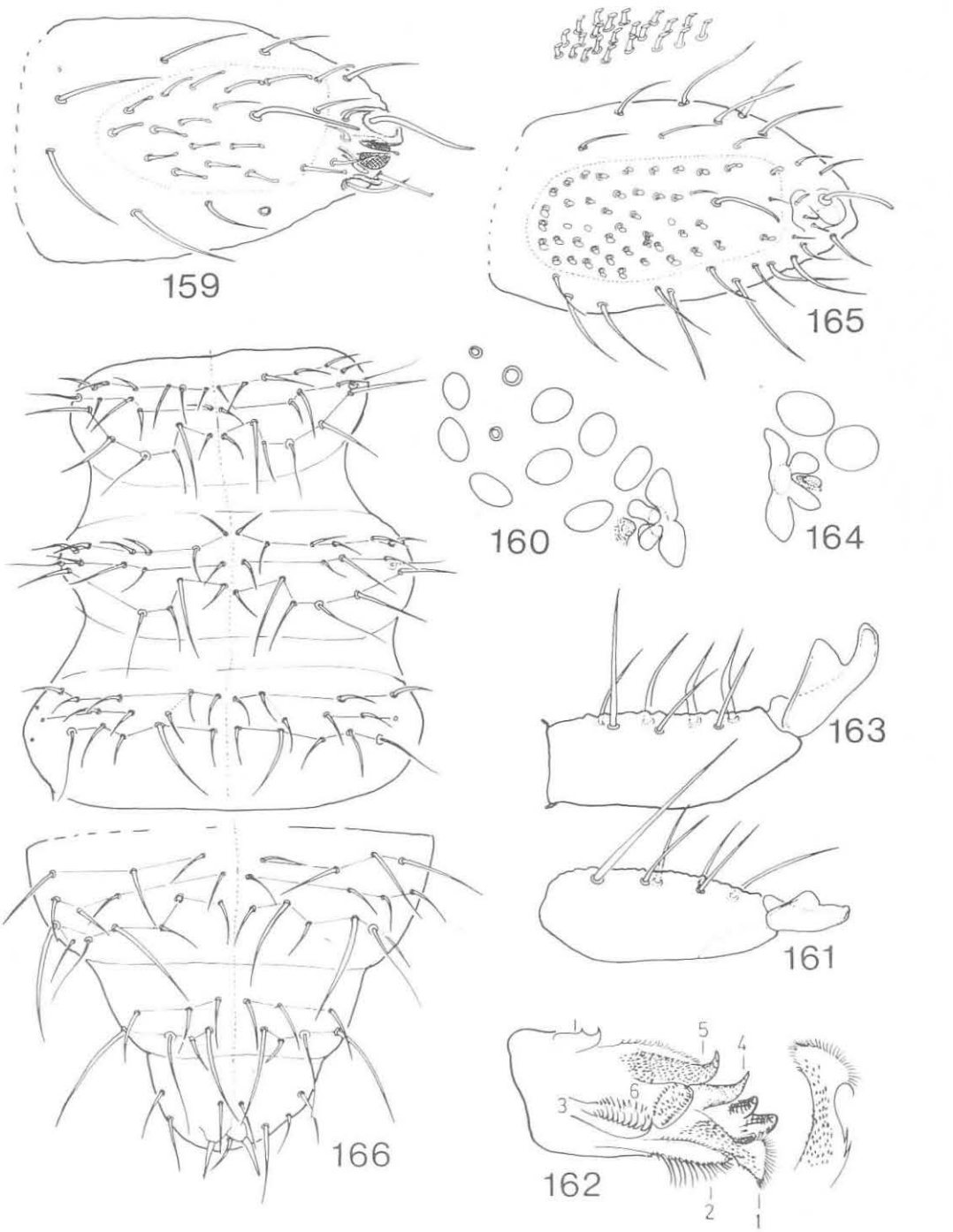
Distribution and ecology

Only found once in a wet snow bed in the Juneau mountains, 3,200 ft. Some specimens are also present from Washington (Ingalls Lake in the Wenatchee Mts., Mt. Rainier, 6,000–8,000 ft.). – *Total distribution:* Nearctic.

30. **Hypogastrura (Cyclograna) loricata** Yosii

Fig. 167.

Hypogastrura loricata Yosii, 1960:264



Figs. 159–166. — 159–162. *Hypogastrura wallmoi* n.sp. — 159. Right Ant.4, ventral. — 160. Right PAO and eyes. — 161. Left dens & mucro. — 162. Left maxilla, inner side. Detail of tip of lam.1. — 163–165. *Hypogastrura krafti*. — 163. Left dens & mucro. — 164. Left PAO. — 165. Right Ant.4, ventral. Detail of file above. — 166. *Hypogastrura maheuxi*. Chaetotaxy of Th.2–Abd.1 & Abd.4–6, holotype.

Discussion

The species is easily identified by the 3+3 cephalic spines (Fig. 167). Lateral sensillae of Th.2–3 are small, spine-like, as in *virga* (Fig. 173). One of my specimens, an unreproductive male, lacks the cephalic spines and has a reduced mucro.

Distribution and ecology

Only a few records from N. Alaska (Franklin Bluffs, Anaktuvuk, Cape Thompson). Collected in Dryas fell-field and in moss and *Salix* litter on a moist river slope. – *Total distribution*: Nearctic.

31. **Hypogastrura (Cyclograna) vulgaris** Yosii

Fig. 174.

Hypogastrura vulgaris Yosii, 1960:263.

Discussion

Characterised by absence of cephalic spines in combination with a PAO having the posterior lobes curved around the accessory boss. A single specimen from Juneau is tentatively identified as *vulgaris*. It is a reproductive male, probably epitokous as the mucro is reduced. As have been observed in *horrida* and *virga* (see below), reduced mucro appears to be correlated with lack of cephalic spines, though in these species the condition was observed in juveniles or subadults. The Juneau specimen may therefore be a form of a normally spined species. However, The lateral sensillae on Th.2–3 differ slightly from those of other Alaskan species (Fig. 174), and also the Ant.4 file is less developed.

Distribution and ecology

A single specimen from moss and lichens near snow in the Juneau mountains, 3,300 ft. – *Total distribution*: Nearctic.

32. **Hypogastrura (Cyclograna) virga** Christiansen & Bellinger

Figs. 172, 173.

Hypogastrura virga Christiansen & Bellinger, 1980:183.

Discussion

This species, described from Oregon, is very characteristic with serrate body hairs, strongly curved anal spines and extremely coarse body granulation. A few juvenile specimens from Juneau have been compared with specimens from the type locality. The Alaskan specimens have much finer granulation – more like *horrida* – and the anal spines are even thicker than in the Oregon specimens (Fig. 172). The lateral sensilla (m_7) on Th.2 is short and spine-like in both samples (Fig. 173). In *horrida* it is slender, hair-like (Fig. 170). Some of the Alskan specimens lack cephalic spines and have reduced mucro.

Distribution and ecology

Only found once in coniferous forest litter (sitka spruce) and mushrooms along Montana Creek Trail near Juneau. – *Total distribution:* Nearctic.

33. **Hypogastrura (Cyclograna) horrida** Yosii

Figs. 168–171.

Hypogastrura horrida Yosii, 1960:266

Description

Colour rather pale with spotted grayish pigment. Head slightly darker. Antennae violet towards tip.

Size 1.4 mm.

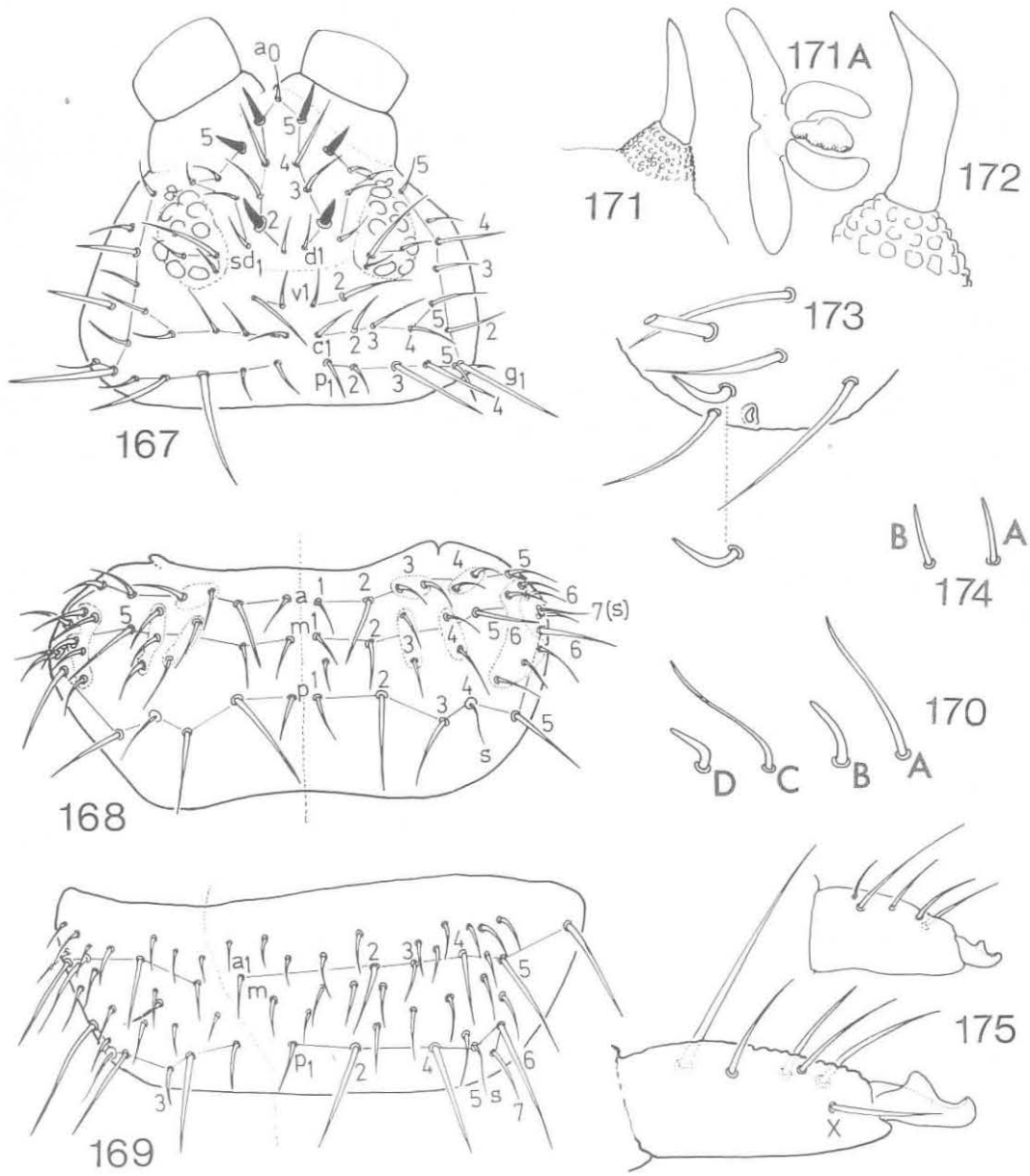
Head. Ant.4 with a dense file, in large specimens with more than 50 sensillae (as Fig. 165). Head with sd_5 and d_5 transformed to spines, rarely these are normal hairs.

Body granulation rather fine, slightly enlarged on last abdominal segments. Large specimens strongly plurichaetotic (Figs. 168, 169). Lateral sensillae on Th.2 normal, hair-like. On Th.3 they are small, spine-like (Fig. 170). Abd.2 with sensilla in position p_6–p_7 spine-like, normal on Abd.1 and 3. Anal spines moderately long, thick, slightly curved (Fig. 171).

Discussion

The species is usually identified by the 2+2 cephalic spines, moderate anal spines and fine granulation. It is only weakly defined from *hiawatha* (Yosii), said to have the inner tooth on unguis nearer to apex.

Christiansen & Bellinger (1980) observed speci-



Figs. 167–175. — 167. *Hypogastrura loricata*. Chaetotaxy of head. — 168–171. *Hypogastrura horrida*. — 168. Chaetotaxy of Th.2. — 169. Abd.4. — 170. Lateral sensillae of A: Th.2 (m_7), B: Th.3 (m_7), C: Abd.1, D: Abd.2. — 171. Anal spines. — 171 A. PAO. — 172–173. *Hypogastrura virga*. — 172. Anal spines. — 173. Lateral part of Th.2. Below: Lateral sensilla (m_7) of Th.3. — 174. *Hypogastrura vulgaris*. Lateral sensilla of Th.2 (A) and Th.3 (B). — 175. *Schaefferia duodecimocellata*. Dens & mucro. Above: Reproductive female. Below: Postreproductive female. x: Extra seta.

mens without cephalic spines in Californian samples. I have seen two such specimens from Alaska. These also have reduced mucro, indicating that epitoky or ecomorphosis may be involved in presence/absence of cephalic spines.

Distribution and ecology

Common and probably present over most of Alaska. *North Slope* (Franklin Bluffs, Toolik Lake, Sagwon Upland, Meade River, Cape Thompson), *Brooks Range* (Galbraith Lake, mts. W of Atigun Camp), *Bering Area* (Nome), *Central* (Bonanza Creek and Gobbler Knob S of Prospect Camp, Mastodon Dome, Eagle Summit, Twelve Mile Mt.), *Alaska Range* (several places along Denali Hwy., Talkeetna Mts.). The species is usually collected in rather damp habitats (willow litter, bogs, alpine wet meadows up to 5,000 ft). Frequent in fresh mushrooms. Distribution in Alaska appears to be arctic/alpine, as it has not yet been found in the rich taiga of the interior (Fairbanks Area). – *Total distribution*: Nearctic, E. Palaearctic (Japan, Nepal).

4.2.2 Genus *Schaefferia* Absolon, 1900

Type species: *Schaefferia emucronata* Absolon, 1900

1. **Schaefferia duodecimocellata** Bonet

Figs. 175, 176.

Schaefferia duodecimocellata Bonet, 1945:19

Description

Colour spotted bluish-gray of variable intensity. Two dorsomedian dark lines are generally present on Th.2–Abd.3. Ventral side pale.

Size 1.3 mm.

Head with 6+6 ocelli, 2 posterior of variable size. Specimens having these 2 ocelli partly or completely fused on one side are seen. Maxilla as in *Hypogastrura denticulata* group (Fig. 137). Maxillary outer lobe with one sublobal hair. Head with normal chaetotaxy, rarely v_1 is absent.

Body macrochaetae smooth or weakly serrate. Chaetotaxy as Fig. 176. On Th.2 seta m_4 sometimes absent or doubled. Abd.1–3 with a'_2 present. On Abd.4 one of the setae in the group m_{4-6} may be absent or double. Dens normally with 5 setae, but frequently one is missing or added. Even single specimens with 3+4 and 6+7 setae are seen (Fig. 175). Tenaculum with 3+3 teeth. Sometimes the distal tooth is split, giving 3+4 or 4+4. Ventral tube with 4+4 setae.

A slight epitoky is observed in reproductive males and females, having reduced mucro (Fig. 175), claws, anal spines and mouth parts.

Discussion

My specimens deviate slightly from Thibaud's (1972) interpretation of the original description of Bonet (1945), based on a single specimen from Mexico. The Mexican species has a more reduced m-row on Abd.1–4. However, Thibaud has examined some of my specimens and agrees they are *duodecimocellata*.

The species is closely related to *cheoha* Wray, 1963 from Tennessee. The latter is insufficiently described, the only apparent difference is the presence of only 3 or 4 setae on dens in *cheoha*. In view of the great variation in number of dental setae in Alaskan *duodecimocellata* (3–7), *cheoha* is possibly a junior synonym.

Distribution and ecology

Several records from snowbed communities at about 3,300 ft in the Juneau mountains. Also a single sample from lush river bank thickets N of Paxson at Richardson Hwy. In Washington I collected the species from meadows and snow-edge communities at Mt. Rainier (8,000 ft) and wet forest meadows and hemlock litter near Ingalls Lake, Wenatchee Mts. – *Total distribution*: Nearctic.

4.2.3. Genus *Bonetogastrura* Thibaud, 1974

Type species: *Typhlogastrura balazuci* Delamare Deboutteville, 1951.

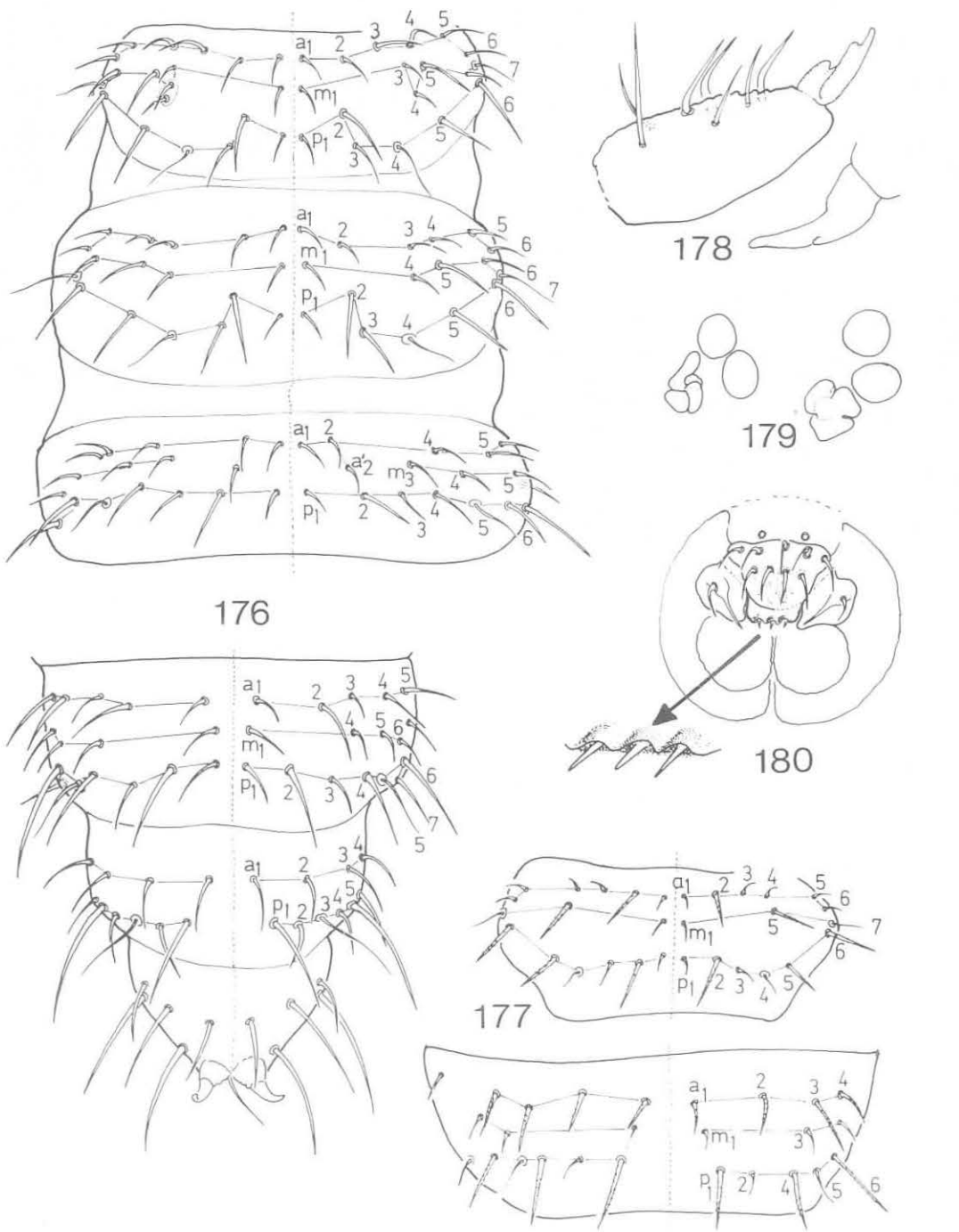
1. **Bonetogastrura variablis** (Christiansen)

Fig. 177.

Schaefferia variablis Christiansen, 1951:125

Discussion

The species is reported from Alaska by Christi-



Figs. 176–180. — 176. *Schaefferia duodecimocellata*. Chaetotaxy of Th.2–Abd.1 & Abd.4–6. — 177. *Bonetogastrura variablis*. Chaetotaxy of Th.2 & Abd.4. — 178–180. *Microgastrura minutissima*. — 178. Dens & mucro. Below: Left mucro, ventral. — 179. PAO from 2 different specimens. — 180. Mouth region with labrum and apical spines (detail).

ansen & Bellinger (1980), but is not present in my own material. I have some specimens from NE Siberia which do not deviate from previous descriptions, apart from a single specimen which has 3+3 ocelli (normally 2+2 or 1+1). Chaetotaxy (Fig. 177) is of the *Hypogastrura armata* type with enlarged a_2 on Th.$_2$ and p_1 longer than p_2 on Abd.4. Also presence of two sublobal hairs indicate a connection to the *armata* line of *Ceratophysella*.

Distribution and ecology

Reported from Umiat and Barrow by Christiansen & Bellinger (1980) and from Colville River by Thibaud (1980). My Siberian specimens were collected in litter of *Alnus fructicosa* in arctic/subarctic tundra. – *Total distribution:* Nearctic – E. Palaearctic (Chukotka: Aborigen, Chaun Bay).

4.2.4. Genus *Microgastrura* Stach, 1922

Type species: *Microgastrura duodecimoculata* Stach, 1922

1. **Microgastrura minutissima** (Mills)

Figs. 178–183.

Achorutes minutissimus Mills, 1934:14

Description

Colour gray or brownish-blue. Ventral side paler.

Size 0.7 mm.

Head. Ant.4 with simple apical bulb, about 10 ventroapical file setae and 6–7 poorly differentiated blunt sensorial setae (Fig. 182). Ocelli 6+6. PAO with 3–4 rather variable lobes (Fig. 179). Labrum with 2 rows of setae, 5–4. Apical edge with 3 lobes covering 3 spine-like projections (Fig. 180). Maxillary outer lobe without sublobal hairs.

Body. Dorsal chaetotaxy simple, Abd.1–4 with complete reduction of the m-row (Fig. 181). Dens with 7 setae, inner 2 apicals thickened and angular (Fig. 178). Mucro as Fig. 178, strongly incurved. Tenaculum with 4+4 teeth. Ventral tube with 4+4 setae. Tibiotarsal tenent hair acuminate. Unguiculus lamellate, reaching less than middle of inner unguis. Anal spines absent. Reproductive males are epitokous with reduced mucro.

Discussion

The Alaskan specimens were compared with *duodecimoculata* from France. The chaetotaxy is identical, but the Alaskan specimens are darker with stronger antennal sensillae, notably the two lateral guard setae of Ant.3 organ.

Distribution and ecology

Only found in SE Alaska at Juneau in forest litter and in subalpine, lush *Athyrium* meadows (Montana Creek Trail). – *Total distribution*: Nearctic.

4.2.5. Genus *Xenylla* Tullberg, 1869

Type species: *Xenylla maritima* Tullberg, 1869

1. **Xenylla humicola** (O. Fabricius)

Figs. 184–186.

Podura humicola O. Fabricius, 1780:213.

Discussion

This classical species is easily identified by the large size (1.3 mm) and strong furca (Fig. 184). Maxillary outer lobe has 3 sublobal hairs (Fig. 185). Maxilla as Fig. 186. Lam.1 with marginal filaments only, no denticles.

Distribution and ecology

Only a few records from southern parts of Alaska: McKinley Park (Wonder Lake Camp), Chugach Mts. (Thompson Pass), Kenai Peninsula (Turnagain Pass), Semidi Isls. (Chowiet Isl.) In forest and meadow litter. – *Total distribution*: Holarctic.

2. **Xenylla canadensis** Hammer

Figs. 187–192.

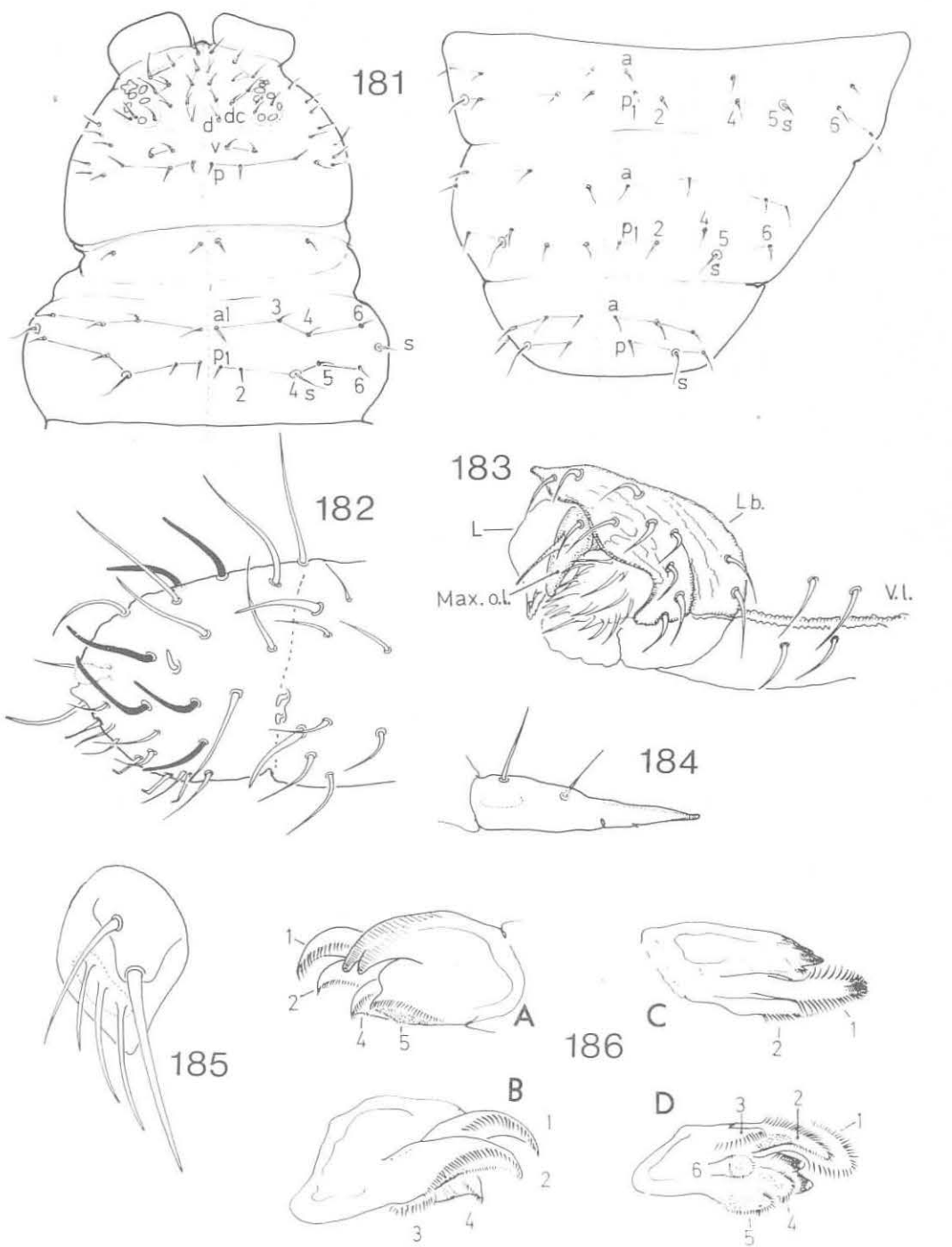
Xenylla canadensis Hammer, 1953:20

Description

Colour dark bluish-gray.

Size 0.6 mm.

Head. Ant.4 with 4 rather slender blunt sensori-



Figs. 181–186. — 181–183. *Microgastrura minutissima*. — 181. Chaetotaxy of head–Th.2 & Abd.3–5. — 182. Left Ant.3–4. — 183. Mouth region, ventrolateral. Lb: Labium, V.l: Ventral line, Max. ol: Maxillary outer lobe, L: Labrum. — 184–186. *Xenylla humicola*. — 184. Dens & mucro. — 185. Right maxillary outer lobe. Sublobal hairs encircled. — 186. Right maxilla. Dorsal (A), ventral (B), outer side (C), inner side (D).

al setae and simple apical bulb (Fig. 191). Ocelli 5+5. Maxillary outer lobe with 2 sublobal hairs. Only 2 prelabral setae present.

Body chaetotaxy as Fig. 187. Characteristics are: Head with p_2 absent, l_1 subequal to l_3. Th.2–3 with all setae present, in small specimens one or two of the la setae may be absent. Abd.1–3 with p_5 absent. Abd.4 without a_3. Abd.5 without a_2. Th.2–3 without ventral setae. Ventral tube with 4+4 setae. Abd.2 sternite with p_1–p_2 present, a_5 absent (Fig. 188). Abd.3 sternite with 1+1 ventromedian setae in front of tenaculum which has 2+2 teeth. Abd.4 with m_1 present (Fig. 190). Tibiotarsi with two clavate tenent hairs. Mucrodens shorter than claw 3, with one seta. No distinct lamella on mucro, but tip sometimes slightly hooked (Fig. 192). Anal spines small. Body granulaion fine.

Discussion

The description above is based on Alaskan specimens. One slide with 3 syntypes labelled "Type. Collembola. Canada 1948. Yellow Knife 395. Xenylla canadensis n.sp. M. Hammer" (Biosystematics Research Institute, Ottawa) was examined. Few details were visible, but in one specimen mucrodens could be examined and it does not differ from the Alaskan form. According to the original description mucro should be distinctly set off from dens by a transverse line. In the specimens I have seen, mucro is completely fused to dens with no clear incision or line (Fig. 192). Although I could not see the chaetotaxy of the type specimens, it is most likely the same species present in Alaska.

The species comes close to *christianseni* Gama and *californica* Gama, with a somewhat intermediary chaetotaxy. The dorsal chaetotaxy is as in *christianseni*, apart from the subequal l_1–l_3 on head and the absence of a_2 on Abd.5. From *californica* it differs by absence of p_5 on Abd.1–3, presence of both p_1 and p_2 on Abd.2 sternite and presence of m_1 on Abd.4 sternite (furca). *X. californica* differs from the other two species by having only 4+4 ocelli. All three species have only one seta on mucrodens, but mucrodens is much shorter in *canadensis* than in other species. (Fig. 193). A similar short mucrodens is found in the species *pallescens* (Scott) which belongs to the same group, but this species has p_5 present on Abd.1–3 and only 1+1 ventromedian setae on Abd.2. Also l_1 on head is much longer than l_3.

Distribution and ecology

Only a few records from *Central Alaska* (Fairbanks area – several places, Eagle Summit). Appears to be pretty abundant in small-grown black spruce taiga (north slopes and boggy terrain). At Eagle Summit in moss in wet alpine tundra. – *Total distribution*: Nearctic.

3. **Xenylla betulae** n.sp.

Figs. 194–201.

Type locality: Alaska. Washington Creek Forest Site N of Fairbanks.
Type material: Holotype: One specimen (alc.) from "Alaska. Washington Creek N of Fairbanks. 28.VII.1976. U. bark, black spruce. A.Fjellberg leg.", at USNM. – *Paratypes*: 32 (26 alc., 6 slide) as above, at USNM. 2 (slide) as above, at AF. 11 (alc.) from "Alaska. Bonanza Creek Exp. Forest, Fairbanks. 8.VIII.1980. U. bark, paper birch. A.Fjellberg leg.", at USNM. 2 (slide) as above, at MCZ. 4 (slide) as above, at BM. 5 (slide) from "Alaska. Fairbanks. 18.IX. 1976. U. bark on fallen Populus balsamifera. A.Fjellberg leg". at MCZ. 2 (slide) from "Alaska. Fairbanks. University Forest Area. 15.- VIII.1980. Rotten Betula trunk on the ground. A.Fjellberg leg.", at USNM.
Derivation of name: After *Betula papyrifera,* the paper birch, on which the species was collected.

Description

Colour pale bluish-gray, eye spot darker.

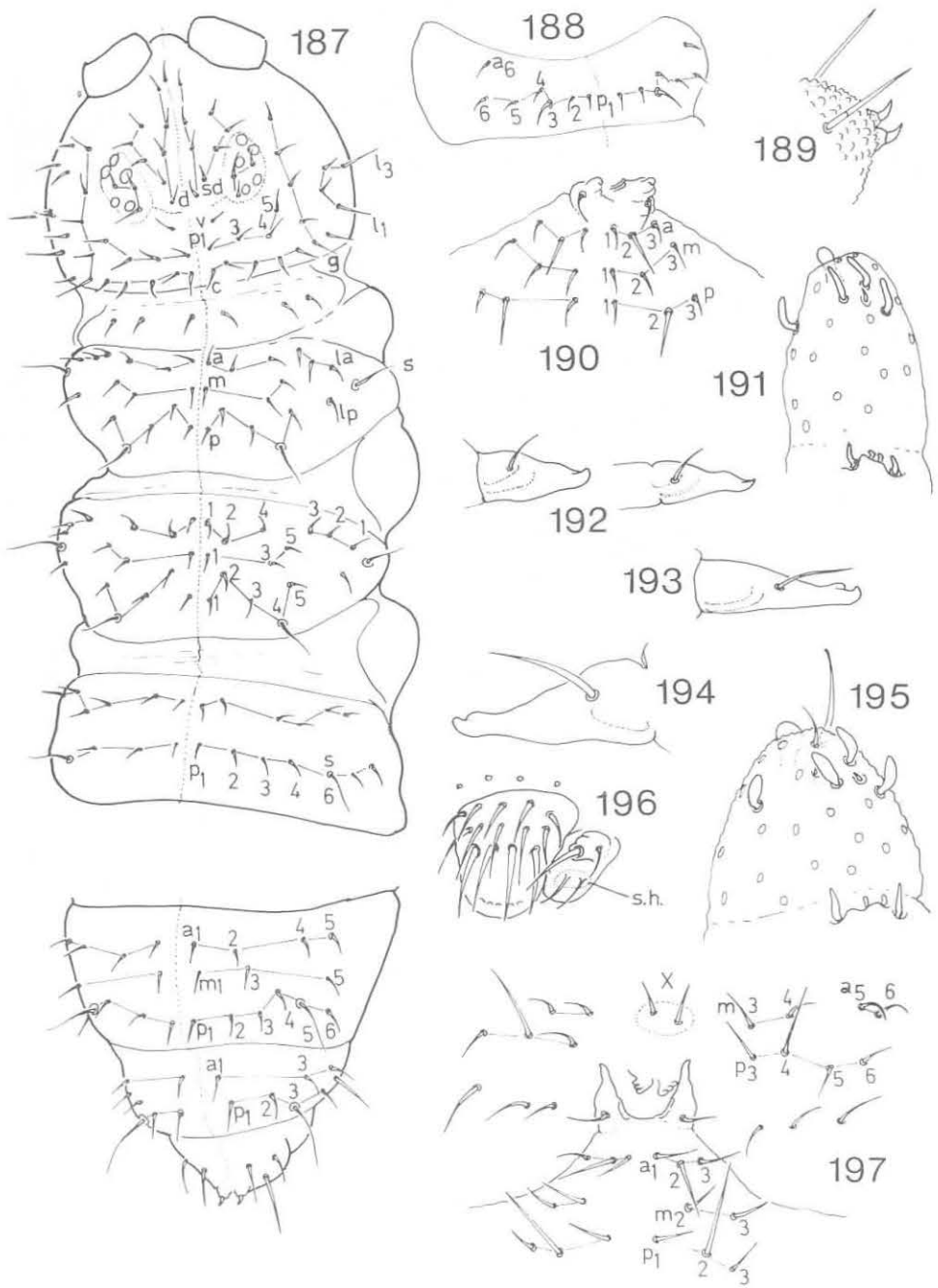
Size 0.9 mm.

Head with 5+5 ocelli. Ant.4 with 4 blunt sensillae and simple apical bulb (Fig. 195). Max.o.l. with 2 sublobal hairs (Fig. 196). Four prelabral setae present. Maxilla as in *humicola* (Fig. 186).

Chaetotaxy as Fig. 198. Characteristics are: Head with p_1 absent. L_1 longer than l_3. Th.2–3 with m_3 and la_1 absent. Abd.1–3 with a_5 present or absent, usually present on Abd.2–3. Rarely both a_3 and a_5 absent, or a_3 absent and a_5 present on Abd.1. Abd.4 with a_3 present or absent. Abd.5 with a_2 absent. Th.2–3 with 1+1 ventral setae. Ventral tube with 4+4 setae. Abd.2 sternite as Fig. 201, p_2 absent, a_5 present. Abd.3 with 1+1 median setae in front of tenaculum which has 3+3 teeth. Abd.4 without ventral seta m_1 (Fig. 197). Tibiotarsi with 2–2–2 long, weakly clavate tenent hairs.

Mucrodens short, about as long as claw 3, with 1 seta. Mucro blunt, with weak lamella (Fig. 194).

Claws with distinct lateral and inner teeth. Anal



Figs. 187–197. — 187–192. *Xenylla canadensis*. — 187. Chaetotaxy of Head–Abd.1 & Abd.4–6. — 188. Abd.2 sternite. – 189. Anal spines. — 190. Abd.4 sternite (furca). — 191. Sensillae on right Ant.3–4. — 192. Dens & mucro of specimen from Alaska (left) and Canadian type (right). — 193. *Xenylla christianseni*. Dens & mucro of specimen from Colorado. — 194–197. *Xenylla betulae* n.sp. — 194. Dens & mucro. — 195. Sensillae on right Ant.3–4. — 196. Labrum and maxillary outer lobe. s.h.: Sublobal hairs. — 197. Chaetotaxy of Abd.3–4 sternites.

spines rather long and slender (Fig. 200). Body granulation moderately coarse.

Discussion

Morphologically this species comes close to *grisea* Axelson and *corticalis* Börner. From both species it differs by having only one seta on dens. Chaetotaxy of head and Abd.2 sternite is as in *grisea* (in *corticalis* p_3 is absent on head and Abd.2 sternite has p_2 present, a_5 absent). Abd.3 sternite is as in *corticalis* (in *grisea* the ventromedian seta pair in front of tenaculum is absent). Following the phylogenetic reasoning of Gama (1969), *betulae* may represent an offspring from the line *grisea* – *corticalis*. The presence of p_3 on head represents a more primitive condition than seen in *corticalis*, but the reduced furca – supposed to be an adaptive character – represents a more advanced stage than in the two other species.

Distribution and ecology

Only a few records from the Fairbanks area in Central Alaska (see type material). The species is corticolous, living under bark on dead trees, both hardwood and conifers. Some specimens were also collected from the Colorado Front Range. – *Total distribution*: Nearctic – E. Palaeartic (Chukotka: Aborigen, under bark of *Larix dahurica*).

4.2.6 Genus *Willemia* Börner, 1901

Type species: *Willemia anophthalma* Börner, 1901

Studies of the maxilla and mouth region of species in this genus have shown only one clear diagnostic character: The number of prelabral setae is either two (*similis, denisi, granulata*) or four (*anophthalma, scandinavica*). Chaetotaxy of labrum is variable, the primary condition with 5–5–4 setae is seen in *denisi*. In other species the middle seta of the upper row is generally absent (4–5–4). Maxillary outer lobe has no sublobal hairs. Maxilla has short, undifferentiated lamellae and appears to be of no practical value for taxonomic separation of the species.

Key

1. PAO normal 2
– PAO granulated (Fig. 215) ..... 6. *granulata* n.sp.
2. Abd.4 with 2+2 setae along median line (Fig. 207) 3
– Abd.4 with 3+3 median setae (Fig. 209) 4
3. Anal spines absent. Two prelabral setae. Ant.4 sensillae egg-shaped (Fig. 205) ..... 1. *denisi*
– Anal spines present. Four prelabral seta. Ant.4 sensillae slender ..... 3. *scandinavica*
4. Anal spines present 5
– Anal spines absent ..... 2. sp. near *denisi*
5. Ant.3 organ narrow (Fig. 210). PAO with 4–5 rather small, spaced lobes (Fig. 212). Four prelabral setae ..... 4. *anophthalma*
– Ant.3 organ wide (Fig. 214). PAO with 6–9 (usually 7–8) more packed lobes (Fig. 213). Two prelabral setae ..... 5. *similis*

1. **Willemia denisi** Mills

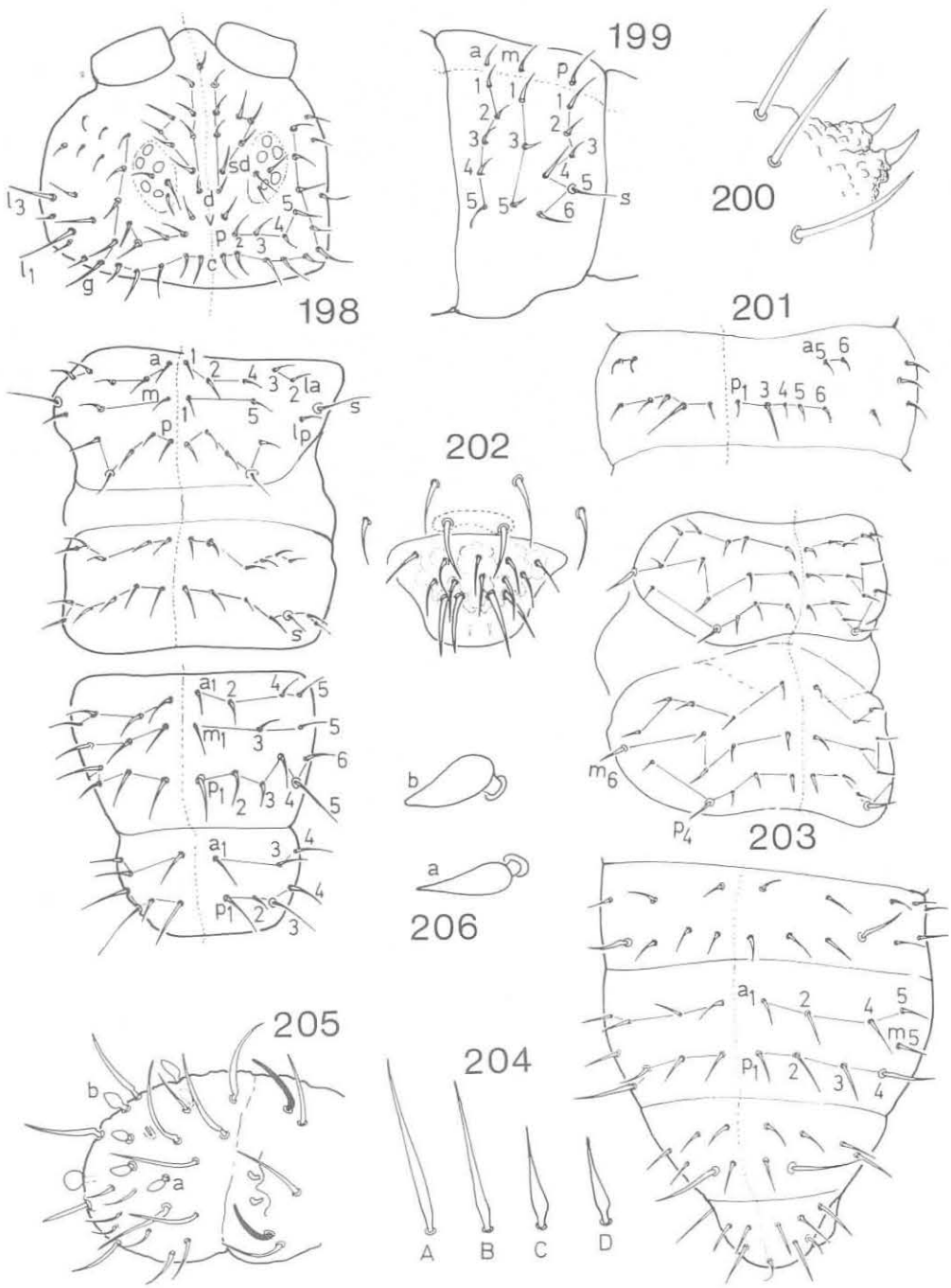
Figs. 202–205.

Willemia denisi Mills, 1932:263.
Willemia aspinata Stach, 1949:250. syn.nov.

Discussion

Absence of anal spines in combination with swollen Ant.4 sensillae identifies this species. Also the Abd.4 chaetotaxy with the reduced m-row is characteristic. Only one m-seta is present (m_3 or m_5), m_1 is always absent (Fig. 203). *W. scandinavica* has a similar chaetotaxy, but two of the lateral m-setae are present (Fig. 209). The Alskan specimens do not differ from specimens from Norway and Colorado. According to Christiansen & Bellinger (1980) *denisi* differs from the European *aspinata* by having flame-shaped sensillae on Abd.4 (p_4) and a hair-like sensillae on Abd.5 (p_2). In *aspinata* also the Abd.5 sensillae are said to be flame-shaped. However, in all specimens at hand the Abd.4–5 sensillae are of same shape, fairly long with dilated base, not different from the Abd.4 sensilla of *denisi* figured by Christiansen & Bellinger (1980 fig. 173e). Hüther (1962) separates *denisi* and *aspinata* by the presence of 5 swollen Ant.4 sensillae and a lamellate unguiculus in the former, and 6 Ant.4 sensillae and a filiform unguiculus in the latter. The Alskan/Norwegian specimens have 5 or 6 (usually 5) sensillae and unguiculus with a clear basal swelling that could be considered a "lamella".

Based on present descriptions and material at hand, I see no reason to separate *aspinata* from *denisi*.



Figs. 198–206. — 198–201. *Xenylla betulae* n.sp. — 198. Chaetotaxy of head, Th.3–Abd.1 & Abd.4–5. — 199. Abd.4 (left side) of a specimen with a_3 present. — 200. Anal spines. — 201. Abd.2 sternite. — 202–205. *Willemia denisi*. – 202. Labrum with prelabral setae encircled. — 203. Chaetotaxy of Th.2–3 & Abd.3–6. — 204. Sensillae on A: Abd.5 (p_2), B: Abd.4 (p_4), C: Abd.3 (p_4), D: Abd.2 (p_4). — 205. Left Ant.3–4. — 206. *Willemia sp.* Ant.4 sensillae, a & b correspond to a & b in Fig. 205.

Distribution and ecology

Probably present all over Alaska. *North Slope* (Canning River Delta, Franklin Bluffs, Sagwon Upland, Meade River, Umiat), *Central*(Fairbanks area, Mastodon Dome), *Aleutian Chain* (Akun Isl., Amchitka, Semidi Isl.), *Alaska Range* (Triangle Peak at Richardson Hwy., several places along Denali Hwy., Talkeetna Mts.), *SE Coast* (Juneau, several records). The species is usually found in rather damp habitats in arctic tundra and subarctic shrub tundra (litter in thickets of *Salix*, *Betula*, etc.). Also in alpine meadows up to 6,000 ft. No records from the richer taiga in Central Alaska. Only at Juneau was the species present in coniferous litter. – *Total distribution:* Holarctic.

2. **Willemia** sp. near **denisi** Mills

Fig. 206.

Many specimens from a single sample collected in Alaska Range (mountains S of 120 mi Denali Hwy., lush snow-bed meadow, 3,500 ft) cannot be identifeid to species. Like *denisi* the anal spines are absent, but Abd.4 chaetotaxy is more complete with m_1, m_3 and m_5 all present. Ant.4 has only four blunt sensillae, of which the two lateral are pointed, the two other more egg-shaped (Fig. 206). There are two prelabral setae. PAO has 4 (3) lobes and the sensillae of Th.2–Abd.5 are as in *denisi*. The species comes close to *biseta* Christiansen & Bellinger, which has anal spines present or absent. That species apparently has the same Abd.4 chaetotaxy, but the 5–6 sensillae in Ant.4 are more prolonged and slender. Also the p_4 sensillae on Th.2–Abd.3 appear weaker.

3. **Willemia scandinavica** Stach

Figs. 207, 208.

Willemia scandinavica Stach, 1949:244.

Discussion

The presence of four prelabral setae in combination with the absence of m_1 on Abd.4 identifies the species. The Ant.4 sensillae as in Fig. 208. Ant.3 organ wide. The p_4 sensilla on Abd.1 is more slender and less flame-shaped than on Abd.2–3. PAO with 6–12 lobes in oval arrangement.

Distribution and ecology

The species appears to have an Arctic/Beringian distribution in Alaska. *North Slope* (Canning River Delta, Meade River), *Bering Area* (Pribilof Isl., St. Paul), *Aleutain Chain* (Buldir, Akun, Chowiet Isl. in the Semidi Isls.). Most records are from rather dry habitats (grass meadows, *Silene/Dryas* hummocks, etc.). Unlike its nearest relatives the species is bisexual as males are generally present. – *Total distribution:* Holarctic.

4. **Willemia anophthalma** Börner

Figs. 209–212.

Willemia anaophthalma Börner, 1901:428.

Discussion

The "narrow" shape of Ant.3 organ separates this species from all other Alaskan species. Distance between the lateral sensillae (LS in Fig. 210) is about 1/3 of the segent width and the small pair of median sensillae is more or less hidden by an integumentary fold. In other species the organ is wider, at least 1/2 of segment width, and the median sensillae are freely exposed.

Distribution and ecology

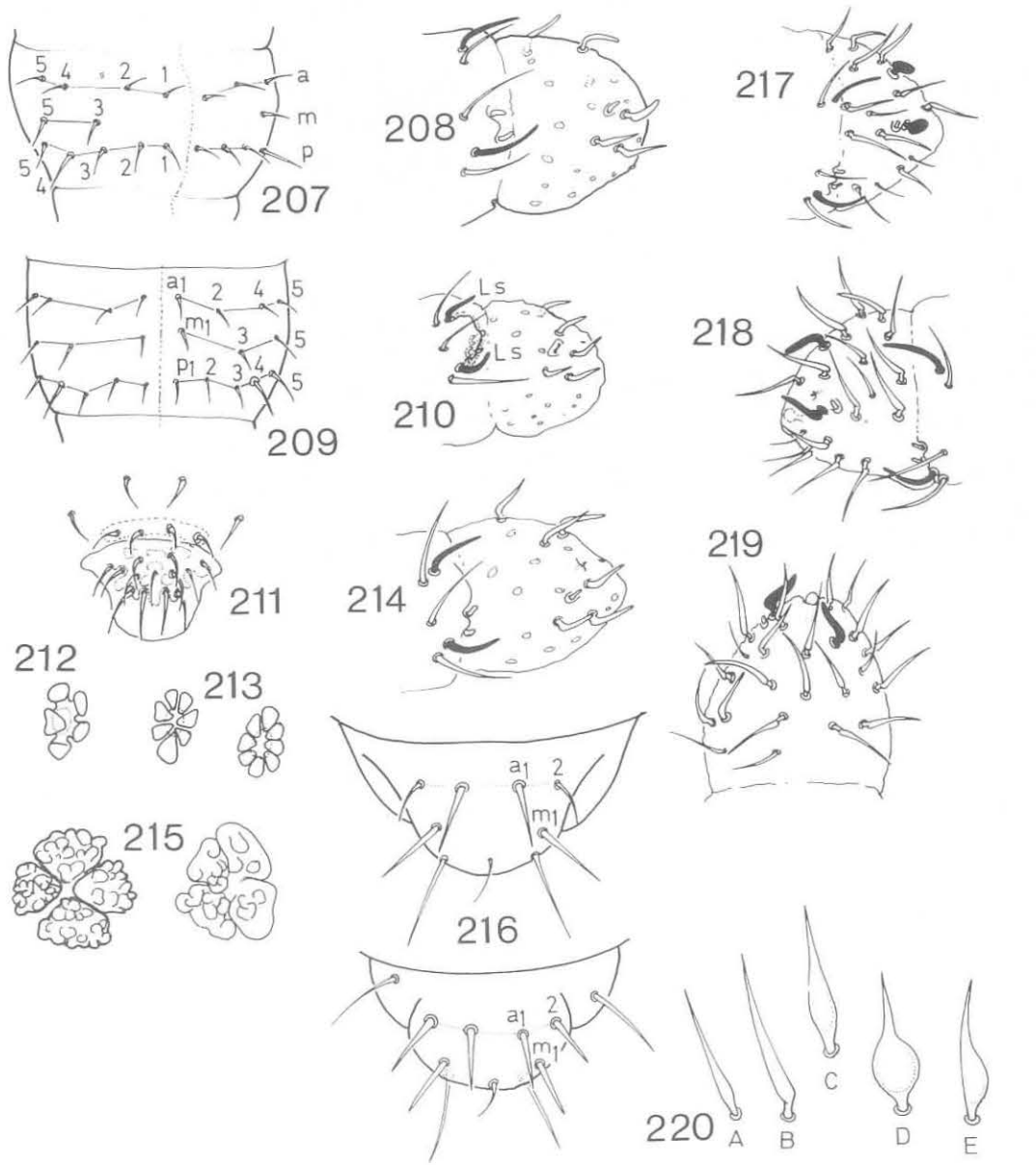
Present all over Alaska. *N. Slope* (Canning River Delta, Meade River, Wainwright), *Bering Area* (Kotzebue, Chevak, Pribilof Isls.), *Aleuian Chain* (Amchitka), *Central* (Fairbanks area, many localities, Mastodon Dome, Gobbler Knob S of Prospect Camp), *Alaska Range* (many sites along Denali Hwy., Flood Creek N of Paxon, Triangle Peak at Richardson Hwy, Talkeetna Mts., Thompson Pass in Chugach Mts.), *SE Coast* (Juneau area).

A common and abundant species in various biotopes, both dry and wet. Unlike the previous species, *anophthalma* is well established in the rich mixed taiga forests of central Alaska. Only females are seen. – *Total distribution:* Holarctic.

5. **Willemia similis** Mills

Figs. 213, 214.

Willemia similis Mills, 1934:19.



Figs. 207–220. — 207–208. *Willemia scandinavica*. — 207. Abd.4. — 208. Sensillae on right Ant.3–4. — 209–212. *Willemia anophthalma*. — 209. Abd.4. — 210. Sensillae on right Ant.3–4. — 211. Labrum with prelabral setae encircled. — 212. PAO. — 213–214. *Willemia similis*. — 213. PAO, 2 different specimens. — 214. Sensillae on right Ant.3–4. — 215–220. *Willemia granulata* n.sp. — 215. PAO of paratype (left) and specimen from Canning River delta (right). — 216. Abd.6 of paratype (above) and specimen from Semidi Isls. (below). — 217. Right Ant.3–4 of Semidi Isls. specimen. — 218. Left Ant.3–4 of paratype, lateral. — 219. Ditto, dorsal. — 220. Sensillae of A: Th.3 (p_4), paratype, B: Th.3 (m_6) paratype, C: Th.2–3 (p_4) of Semidi Isls. specimen, D: Th.3–Abd.1 (p_4) of Canning River specimen, E: Abd.3 (p_4) of same.

Discussion

The identity of this species is rather obscure. According to Christiansen & Bellinger (1980) PAO has 8–12 lobes, my specimens have 6–9, usually 7 (Fig. 213). Unguiculus is said to have a clear basal swelling, my specimens have a filiform unguiculus like *anophthalma*. Christiansen & Bellinger (1980 fig. 176b) figures the chaetotaxy of Abd.4 in a type specimen, showing 4 m-setae. My specimens have 3 (as in Fig. 209). The species is readily separated from *anophthalma* by its broad Ant.3 organ, more PAO lobes and presence of only two prelabral setae.

Distribution and ecology

The most common of all the Alaskan *Willemia* species. Many records from all over the state. *N. Slope* (Meade River, Barrow, Colville River Delta, Umiat, Prudhoe Bay, Canning River Delta, Happy Valley Cut, Sagwon Upland, Franklin Bluffs, Toolik Lake, Cape Thompson), *Bering Area* (Kotzebue), *Brooks Range* (mts. W of Atigun Camp, Galbraith Lake, Atigun River, Anaktuvuk, Sukakpak Mt. S of Dietrich Camp, "Last Spruce" S of Chandalar), *Central* (Finger Mts. S of Old Man Camp, Gobbler Knob S of Prospect Camp, Fairbanks area – many localities, Mastodon Dome, Eagle Creek, Twelve Mile Mt. at Steese Hwy., Ft, Yukon, Delta), *Alaska Range* (McKinley Park at Eielson, Wonder Lake Camp and Sanctuary River, many sites along Denali Hwy., Talkeetna Mts.), *Aleutian Chain* (Adak), *SE Coast* (Turnagain Pass at Homer, Junea area).

The species is common and abundant in samples from a great variety of habitats, both wet and dry. Only females are seen, except in a single sample from Delta where males are present. That sample came from a rather special habitat: Dry, sandy flood plain with scattered, unstable vegetation (mainly Leguminosae). – *Total distribution*: Holarctic. I have seen specimens from NE Siberia (Chaun Bay), Spitsbergen (Ny Ålesund) and Greenland (Mörkefjord).

6. **Willemia granulata** n.sp.

Figs. 215–221.

Type locality: Alaska. Ft. Yukon.
Type material: Holotype: Female (slide) from "Alaska. Ft. Yukon, 29.VIII. 1976. Moss & spruce litter. S. Campbell leg.", at USNM. – *Paratypes:* All slides from the holotype series, deposited as follows: 14 at USNM, 3 at MCZ and 4 at BM.
Derivation of name: From the granulated appearance of PAO.

Description

Colour white.
Size 0.5 mm.
Head. Ant.3-4 as Fig. 218. Ant.4 with a simple, withdrawn apical bulb. All long hairs in Ant.4 are slightly angular and widened at base. Only two sensillae (black in Fig. 218) are notably thicker than others. Labrum with 5–5–4 or 4–5–4 setae. Only two prelabral setae present. Ocelli absent. The four primary PAO lobes have numerous finger-like papillae (Figs. 215, 221).

Body. Chaetotaxy as Fig. 221. Head with 3+3 setae along ventral line. Th.1 with 3+3 setae. Th.2–Abd.3 with normal chaetotaxy. The p_4 sensillae on Th.2–Abd.1 moderately widened at base (Fig. 220), on Abd.2–3 more distinctly so. On Abd.4–5 the sensillae are long and slender, longest on Abd.5. The lateral sensilla (m_6) on Th.2–3 about as m_4 on Abd.3 (Fig. 220 B). Abd.4 without p_5, but a_5 and m_5 are present. The m_3 present or absent, m_1 and m_4 always present. Abd.6 with a_1 and m_1 long, straight. The a_2 is finer, curved (Fig. 216, above). Ventral tube with 4+4 setae. Unguiculus without distinct lamella, reaching middle of inner edge of unguis. Anal spines absent.

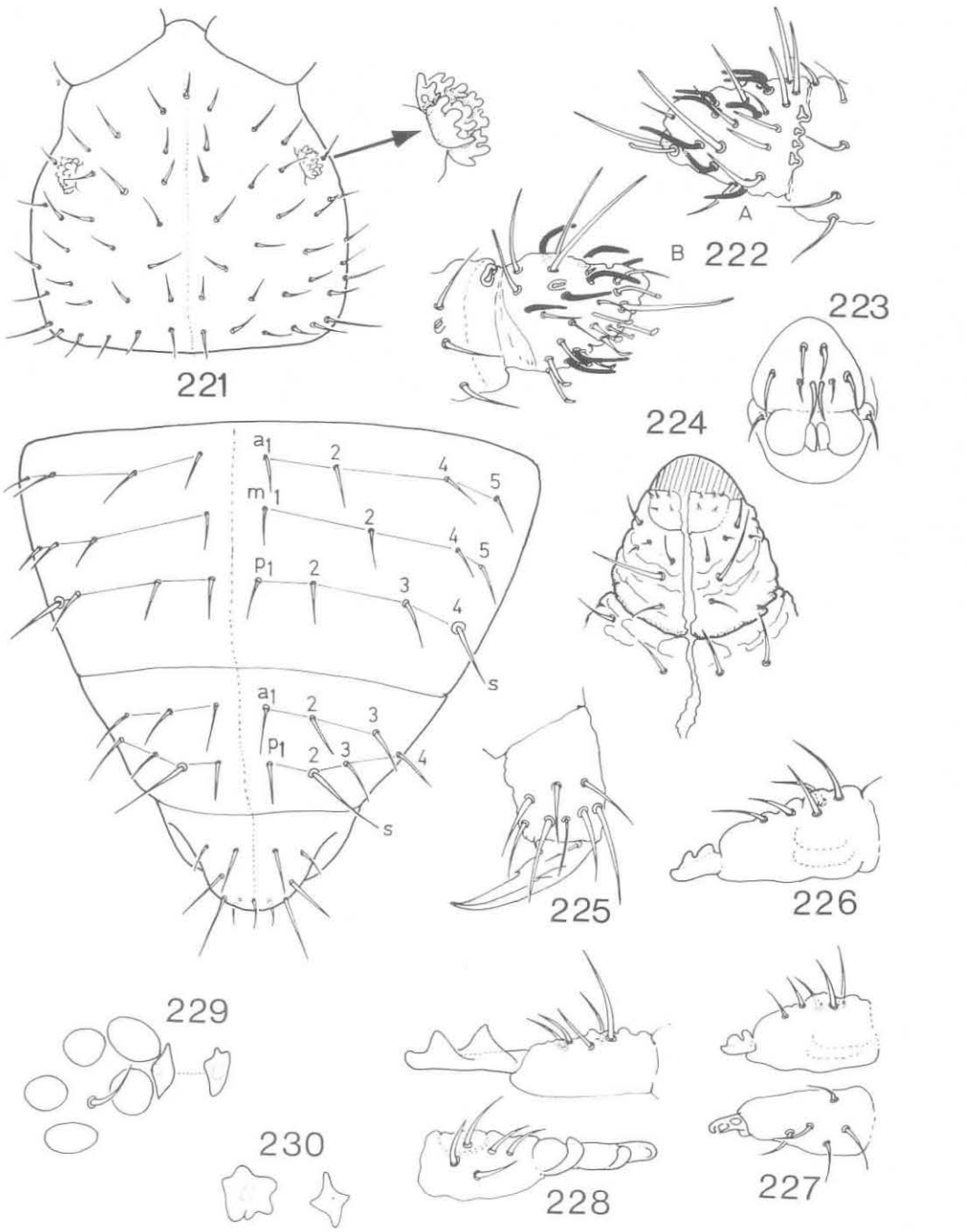
Discussion

The unique PAO readily separates this species from other *Willemia*.

The above description is based on a series of specimens from Ft. Yukon. Specimens from other populations differ considerably in development of sensillae on Ant.4, thorax and abdomen:

a) A single specimen from Canning River Delta has a very swollen p_4 sensilla on Th.3 and the first three abdominal segments (gradually decreasing) (Fig. 220 D). It also differs from the main form by presence of two extremely small anal spines.

b) A number of specimens from Semidi Isls., Galbraith Lake and Toolik Lake differ from the main form by having 2 strongly swollen Ant.4 sensillae (Fig. 217). The p_4 sensilla on Th.2–Abd.3 are all similar, more strongly flame-shaped than in f. *typica*. On Abd.6 setae a_1, a_2 and m_1 are all similar, long and straight (Fig. 216 below). In particu-



Figs. 221–230. — 221. *Willemia granulata* n.sp. Chaetotaxy of head and Abd.4–6, with detail of PAO. — 222–230. *Odontella coronifer*. — 222. Ant.3–4. A: Left lateral, B: Right ventrolateral. — 223. Labrum. — 224. Labium. — 225. Tip of T.1. — 226. Dens & mucro of reproductive female. — 227. Dens & mucro of reproductive male. — 228. Dens & mucro of nonreproductive female. — 229. Right eyes and PAO with left PAO at side. — 230. PAO of 2 other specimens.

lar the four a-setae make a rather striking transverse row of spine-like setae. In f. *typica* a_2 is a normal hair – short, fine and curved.

The variation described above may indicate that more than one species are involved. However, in view of the few and geographically distant samples, I prefer to distinguish only one species at present, based on the unique PAO.

Distribution and ecology

The main form appeared in moss and spruce litter at Ft. Yukon in Central Alaska. The other forms are form:

Form a: North Slope: Canning River Delta, owl mound.

Form b: North Slope: Toolik Lake, dry stony moraine vegetation. *Brooks Range:* Mts. across Galbraith Lake Camp, in dry *Rhododendron* litter on SW slope. *Aleutian Chain*: Chowiet Isls. in the Semidi Isls., meadow vegetation. A single specimen of the b-form was also found in the Colorado Front Range. – *Total distribution:* Nearctic.

4.3 Family Odontellidae

4.3.1. Genus *Odontella* Schäffer, 1897

Type species: Odontella loricata Schäffer, 1897

1. **Odontella coronifer** Mills

Figs. 222–231.

Odontella coronifer Mills, 1934:25.

Description

Colour pale spotted bluish-gray, slightly darker on head.

Size 0.8 mm.

Head. Ant.4 with 8 blunt sensillae and 8–10 long, flat-topped file setae (Fig. 222). Apical bulb absent. No ventral sac between Ant.3–4. Ocelli 5+5. PAO usually quadrangular, but rather variable (Fig. 230). Labrum with 8 setae (Fig. 223). Basal part of labium with 6 setae, of which two are much smaller than other. Apical part (palp) of labium with 5 spinules (Fig. 224).

Body. Granulation coarse, with roundish or elongate rather irregular tubercles. Chaetotaxy as Fig. 231. Dens and mucro as Figs. 226–228. Dens usually with 5 dorsal setae, sometimes 3 or 4. Claws with variable inner and lateral teeth. Tenent hair acuminate (Fig. 225).

Discussion

A number of specimens from the Juneau area have an elongate PAO as Fig. 229, approximating that of the Californian species *biloba* Christiansen & Bellinger. All these specimens are juvenile or unreproductive adults. In same samples appear reproductive males which all have an angular PAO (Fig. 230) and reduced mucro (Fig. 227). Also the integument is finer with more regular roundish tubercles, the anal spines are shorter and hairs on the ventral anal flaps are shorter and finer. These males are most likely epitokous specimens of the form with the elongate PAO and a normal mucro.

The Alaskan specimens have been compared with specimens of *coronifer* from California, and no definite difference could be detected.

Distribution and ecology

Several scattered records in Alaska. *North Slope* (Toolik Lake, Happy Valley Cut), *Brooks Range* (mts. across Galbraith Lake Camp, mts. W of Atigun Camp), *Central* (Gobbler Knob S of Prospect Camp), *Alaska Range* (mts. S of 130 mi Denali Hwy.), *Aleutian Chain* (Amchitka), *SE Coast* (Juneau). The records are all from rather dry habitats in arctic/alpine tundra. – *Total distribution:* Nearctic – ? E. Palaearctic (Christiansen & Bellinger (1980) consider the Japanese *O. similis* Yosii to be the same as *coronifer*).

4.3.2 Genus *Xenyllodes* Axelson, 1903

Type species: Xenyllodes armatus Axelson, 1903

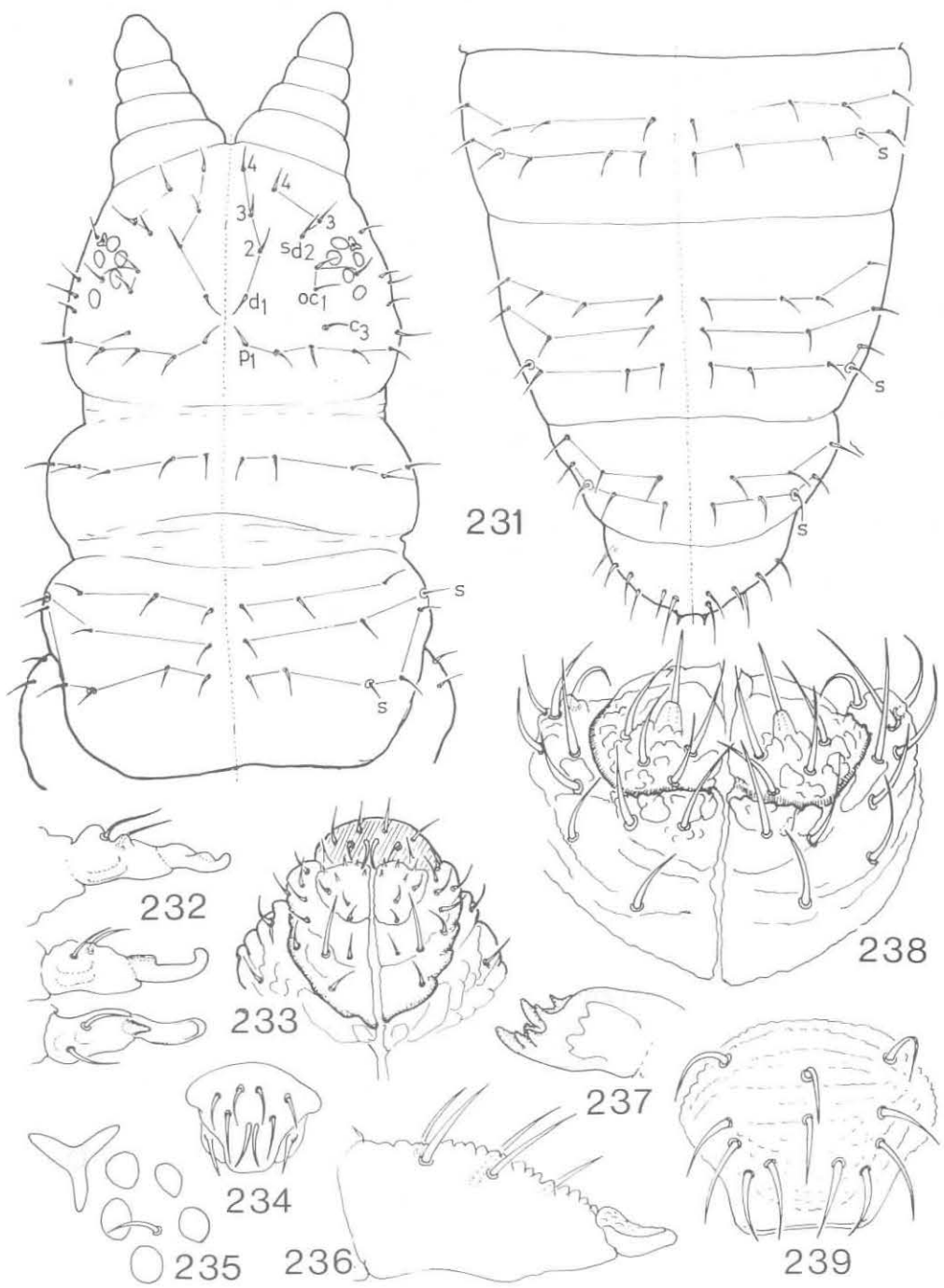
1. **Xenyllodes armatus** Axelson

Figs. 232–235.

Xenyllodes armatus Axelson, 1903:4.

Discussion

The characteristic mucro and star-shaped PAO readily identifies this species (Figs. 232, 235). Labrum with 8 setae. Max.o.l. with a simple, long palp



Figs. 231–239. — 231. *Odontella coronifer*. Chaetotaxy of Head–Th.2 & Abd.3–6. — 232–235. *Xenyllodes armatus*. — 232. Dens & mucro, 2 different specimens. — 233. Labium. — 234. Labrum. — 235. Left PAO and eyes. — 236–239. *Brachystomella parvula*. — 236. Dens & mucro. — 237. Maxilla. — 238. Labium. — 239. Labrum.

without basal setae and sublobal hairs (Fig. 234). Labium as Fig. 233, basal part with 9 setae, apical part with 3 setae and 5 spine-like projections.

Distribution and ecology

Apparently present all over Alaska. *North Slope* (Meade River, Barrow, Umiat, Toolik Lake, Happy Valley Cut, Franklin Bluffs), *Brooks Range* (mts. across Galbraith Lake Camp, Atigun River, mts. W of Atigun Camp, Anaktuvuk, "Last Spruce" S of Chandalar), *Central* (Ft. Yukon, Eagle Creek, Twelve Mile Mt., Kanuti River S of Old Man Camp, Fairbanks), *Alaska Range* (mts. S of 130 mi Denali Hwy.) *Bering Area* (Kotzebue, Chevak), *SE Coast* (Juneau). Most records are are from rather dry sites in arctic/alpine tundra. Some of the sample from Centraal Alaska were from fairly damp places (*Sphagnum* bogs, willow litter, deep spruce litter). – *Total distribution:* Holarctic.

4.4 Family Brachystomellidae

4.4.1. Genus *Brachystomella* Ågren, 1903

Type species: Schoettella parvula Schäffer, 1896

1. **Brachystomella parvula** (Schäffer)

Figs. 236–239.

Schoettela parvula Schäffer, 1896:176

Discussion

The maxilla (Fig. 237) is unique and readily identifies this genus which has only one species in Alaska. Labrum and labium as Figs. 238, 239. Dens and mucro as Fig. 236. PAO with 4–8 lobes. Alaskan specimens have been compared with Norwegian, and no difference could be found.

Distribution and ecology

Mostly from the *North Slope* and arctic coast (Canning River Delta, Prudhoe Bay, Franklin Bluffs, Smith River at Lonely, Meade River, Barrow, Icy Cape). Some records from the *Bering Area* (Kotzebue, Cape Krusenstern). Usually in damp litter in polygon troughs, on stream banks, etc. – *Total distribution:* Holarctic.

4.5 Family Neanuridae

4.5.1 Genus *Friesea* Dalla Torre, 1895

Type species: Triaena mirabilis Tullberg, 1871

1. **Friesea mirabilis** (Tullberg)

Fig. 240.

Triaena mirabilis Tullberg, 1871:155.

Discussion

Easily identified by the 3 anal spines and acuminate body hairs. Alaskan specimens often have the longer tibiotarsal hairs truncate or weakly clavate. Also the macrochaetae on Abd.6 may be blunt-tipped or slightly clavate, but never distinctly knobbed as in the related *claviseta*.

Distribution and ecology

Probably present all over Alaska. *North Slope* (Canning River Delta, Prudhoe Bay, Franklin Bluffs, Sagwon Upland, Toolik Lake, Meade River, Wainwright), *Brooks Range* (Atigun River, mts. W of Atigun Camp, mts. across Galbraith Lake Camp), *Bering Area* (Cape Krusenstern, Kotzebue, Nome, Bethel, Nunivak Isl., Pribilof Isl.), *Central* (Gobbler Knob S of Prospect Camp, Kanuti River S of Old Man Camp, Ft. Yukon, Twelve Mile Mt., Fairbanks), *Alaska Range* (Wonder Lake in McKinley Park, many sites along Denali Hwy., Triangle Peak at Richardson Hwy., Watana Mt. in Talkeetna Mts.), *SE Coast* (Juneau). Common in many different habitats, both wet and dry. – *Total distribution*: Holarctic.

2. **Friesea claviseta** Axelson

Fig. 241.

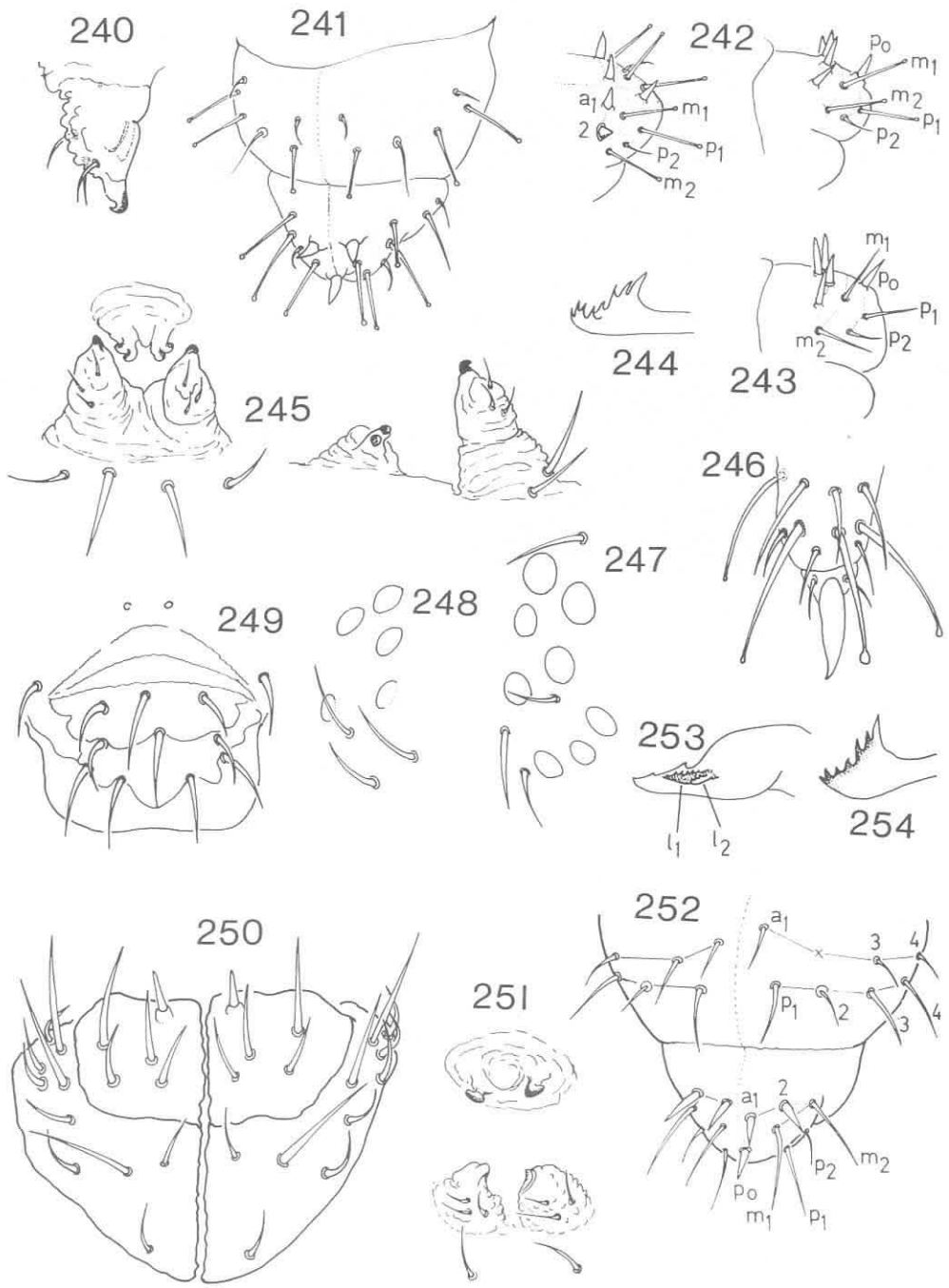
Friesea claviseta Axelson, 1900:112.

Description

Colour grayish-blue to dark bluish-black.

Size 0.8 mm.

Head Mandible with 7–8 teeth. Maxilla with 7–8 teeth on the large dorsal lamella, with two teeth on the small lamella (cf. Fig. 253). Furca reduced, dens with three setae. Mucro absent or present as



Figs. 240–254. — 240. *Friesea mirabilis*. Furca. — 241. *Friesea claviseta*. Abd.5–6. — 242. *Friesea millsi*. Abd.6, dorsal and lateral. — 243. *Friesea quinquespinosa*. Abd.6, lateral. — 244–247. *Friesea millsi*. — 244. Mandible. — 245. Furca & tenaculum, ventral and lateral. — 246. Tip of T.3. — 247. Right eye field. — 248–254. *Friesea quinquespinosa*. — 248. Left eye field, syntype. — 249. Labrum. — 250. Labium. — 251. Furca & tenaculum, syntype. — 252. Abd.5–6, syntype. — 253. Maxilla. — 254. Mandible.

a small hook. Tenaculum with 2+2 teeth. Tibiotarsi with 2–3–3 long, clavate tenent hairs. Also the long ventrodistal hairs clavate.

Body. Macrochaetae on tip of abdomen knobbed (Fig. 241).

Discussion

The strength of the clavate tibiotarsal and abdominal hairs vary considerably. Some specimens are hardly separable from *mirabilis*.

Distribution and ecology

Far less common than *mirabilis*. *Central* (Eagle Summit, Eagle Creek, Mastodon Dome), *Bering Area* (Chevak, Norton Bay), *SE Coast* (Juneau). Present in both wet and dry habitats (thick turf in owl mound, willow litter along creeks, snow-bed meadows, mesic *Sphagnum* upland, etc. – *Total distribution*: Holarctic.

3. **Friesea millsi** Christiansen & Bellinger

Figs. 242, 244, 247.

Friesea millsi Christiansen & Bellinger, 1974:389.

Discussion

This is the only Nearctic species with 5 anal spines and clavate abdominal hairs. My specimens differ slightly from the original description: They are darker (dark blue) with less reduced furca (about 1.5 a long as posterior anal spine) and apparently more strongly clavate tibiotarsal hairs (2–3–3 dorsal and 4 or 5 ventral). Maxilla of the single Alaskan adult is very similar to *quinquespinosa* (Fig. 253) with two teeth along the cutting edge. Lam.1 has 6 teeth and lam.2 has two teeth. *F. millsi* is said to have a single tooth on capitulum and "Smaller lamella tridentate" (Christiansen & Bellinger 1980). Mandible has 8 teeth (Fig. 244).

The species comes close to *quinquespinosa* which has 5+5 (6) ocelli (8+8 in *millsi*), a shorter furca and never distinctly clavate abdominal hairs.

Distribution and ecology

A few specimens collected in dry moss and lichens on exposed rocks at Finger Mts., S of Old Man Camp in Central Alaska. – *Total distribution*: Nearctic

4. **Friesea quinquespinosa** Wahlgren

Figs. 243, 248–254.

Friesea quinquespinosa Wahlgren, 1900:368.
Friesea nauroisi Cassagnau, 1958:26. Syn.nov.

The following description is based on two syntypes from Greenland, labelled "Riksmuseets Entomologiska Afdelning. Friesea V-spinosa Wahlgr., Cap Stewart. Colleg. Grönl.-Exp.22, Determ. E. Wahlgren", kept at Naturhistoriska Riksmuseet, Stockholm. Recent material from Alaska, NE Siberia and Spitsbergen is also included.

Description

Colour grayish-blue with darker eye spots.
Size 1.5 mm.
Head with 5+5 (6) ocelli (Fig. 248). Labrum, labium, maxilla and mandible as Figs. 249, 250, 253, 254.
Body hairs generally smooth and acuminate, sometimes the longer abdominal macrochaetae become serrate and blunt or weakly clavate. Even the tibiotarsal hairs may be slightly clavate. Abd.6 with 5 anal spines (Fig. 243). Specimens with asymmetric or deformed spines are frequent. Dens with three setae, tenaculum with 2+2 teeth, rarely 1+1.

Discussion

The original description of *quinquespinosa* states 3+3 ocelli. The single type specimen that was checked has 5 ocelli on the one side and at least 4 on the other. The two posterior ocelli are slightly reduced and were possibly overlooked by Wahlgren. Cassagnau (1958) described *nauroisi* from Spitsbergen, differing from *quinquespinosa* by having 6+6 ocelli. One of my Aleut specimens has 5 ocelli on the one side and 6 on the other, indicating that eye number is not reliable. Although I have not seen the types of *nauroisi*, I have examined numerous specimens from various parts of Spitsbergen which can hardly be anything else than the species Cassagnau described. They all have 5+5 ocelli.

Another species in the complex is *quinta* Christiansen & Bellinger, 1974, described from specimens collected under bark in Mexico. The authors separate that species from *quinquespinosa* (=*nauroisi*) by absence of a_2 on Abd.5 in the former. Ho-

wever, in samples of *quinquespinosa* from Alaska, Chaun Bay and Spitsbergen the seta a_2 may either be present or absent, often just on the one side (Fig. 252). Thus the character is not reliable. *F. quinta* is said to have 4 or 5 (rarely 3) ocelli. The species should be reexamined.

Distribution and ecology

The present records indicate an Arctic/Beringian distribution in Alaska. The species appear to be very common in the Aleutian Isls. *North Slope* (Meade River, Barrow), *Alaska Range* (Summit Lake N of Paxson), *Bering Area* (Chevak, Inglutalik River in Norton Bay), *Aleutian Chain* (Buldir, Akun, Atka, Adak, Amchitka, Unimak, Semidi Isls.), *SE Coast* (Juneau). Generally present in rather damp habitats (meadows, pond edge vegetation, detritus on stream banks), but also in arctic fell fields with moss, lichens, *Empetrum*, etc. The Juneau specimens were found in thick layers of sitka spruce litter. – *Total distribution*: Holarctic (Spitsbergen , Greenland, Alaska, NE Siberia (Chaun Bay)).

5. **Friesea alaskella** n.sp.

Figs. 255–261

Type locality: Alaska. Spinach Creek at Murphy Dome Road, Fairbanks.
Type material: Holotype: Female (slide) from "Alaska. Fairbanks. Murphy Dome Rd., Spinach Creek. 23.VII.1980. Alder/willow litter at creek. A.Fjellberg leg.", at USNM – Paratypes: (Allotype) male (on same slide as holotype), at USNM. 3 (slide) from "Alaska. Fairbanks. Murphy Dome Rd., W of Spinach Creek. 21.VII.1980. Mixed deciduous litter, mainly birch. A.Fjellberg leg.", at USNM. 1 (slide) as above, at BM. 1 (slide) as above, except "Aspen leaf litter", at USNM.
Derivation of name: Diminutive form of Alaska.

Description

Colour white. Eye pigment was not noted before slides were made. If present, only as very small spots under each ocellus.

Size 1.0 mm.

Head with 2+2 ocelli (Fig. 258). Ant.4 with simple, withdrawn apical bulb. The 7–8 blunt sensorial setae slightly differentiated, the three apical ones largest (Fig. 261). Chaetotaxy of labium and labrum normal, as Fig. 249, 250. Maxilla with two small teeth on cutting edge of capitulum. Lam.1 with 4–5 teeth. Mandible with 7 teeth (only 1 specimen checked).

Body hairs smooth, acuminate. Chaetotaxy as Fig. 255. Individual variation frequent, though Abd.5–6 rather constant (2 specimens have a_2 present on the one side of Abd.5). Abd.6 with 6 anal spines (a_1, a_2, m_1, Fig. 255). Claws simple, without teeth. Tenent hairs short, acuminate. Ventral tube with 4+4 setae. Mucro absent (Fig. 260).

Discussion

The combination of 6 anal spines and 2+2 ocelli is found in no other Nearctic *Friesea*. *F. fara* Christiansen & Bellinger has 6 spines, but a full set of eyes (8+8). *F. wilkeyi* Christiansen & Bellinger and *cardiosa* (Wray) are the only other Nearctic species with 2+2 eyes, but the former has only 2 anal spines and the latter has 8 or more anal spines and furca/tenaculum absent.

Distribution and ecology

Only found in the Fairbanks area in Central Alaska in litter of mixed deciduous forest. – *Total distribution:* Nearctic.

4.5.2. Genus *Pseudachorutes* Tullberg, 1871

Type species: *Pseudachoutes subcrassus* Tullberg, 1871.

Several of the 13 Nearctic species listed by Christiansen & Bellinger (1980) are only superficially known and poorly described. In Alaska there are two very distinct and rather common species. Unfortunately they can not be definitely identified at present.

1. **Pseudachorutes** cf. **indiana** Christiansen & Bellinger

Figs. 262–268.

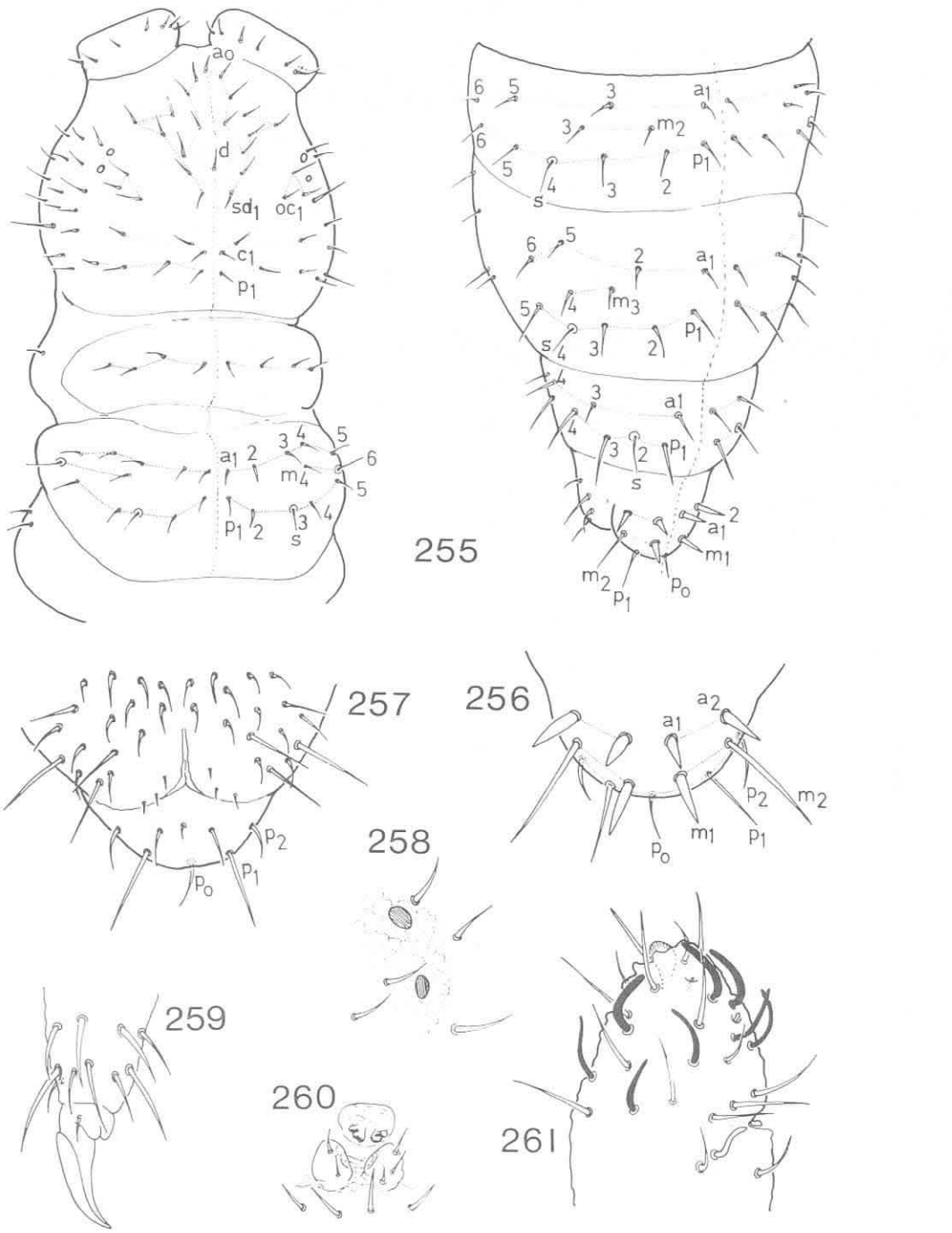
Pseudachorutes indiana Christiansen & Bellinger, 1980:312.

Description

Colour dark bluish-gray.

Size 1.7 mm.

Head. PAO with 10–14 lobes, only slightly lar-



Figs. 255–261. *Friesea alaskella* n.sp. — 255. Chaetotaxy of Head–Th.2 & Abd.3–6, holotype. — 256. Abd.6. — 257. Abd.6, ventral. — 258. Eyes, right side. — 259. Tip of T.1. — 260. Furca & tenaculum. — 261. Right Ant.3–4, dorsal.

ger than an eye (Fig. 265). Apex of labrum and labium prolonged (Figs. 263, 264). Labium with 8 setae in the basal part, apical part with 4 setae, 1 spinule (sp) and 3 small papillae (p), probably sensorial. Maxilla styliform, with 2 small apical teeth. Mandible thin, membraneous, with 4 teeth (Fig. 266). Chaetotaxy as Fig. 262. Head simple, with unpaired d_1. Th.1 with 4+4 setae. Th.2–3 with reduced m-row, only lateral sensilla (m_6) present.

Body. Abd.1–2 with only one a-seta (a_3) present in front of p_3–p_4. The m-row reduced, only m_6 present. Ventral tube with 4+4 setae. Claws with simple or more or less serrate inner tooth (Fig. 267). Furca strong, with slender dens (Fig. 268). Body granulation coarse.

Discussion

Following the key of Christiansen & Bellinger (1980), specimens having serrate inner tooth on unguis (Fig. 267) will key to *aureofasciatus* (Harvey). However, in Alaskan material such specimens do not differ from specimens with simple claws present in the same sample. Chaetotaxy of the Alaskan species is like *indiana* (Christiansen & Bellinger, 1980 fig. 233 A). In *aureofasciatus* one m-seta (m_4) is present in front of p_3–p_4 on Abd.1–3 (Christiansen & Bellinger 1980 fig. 228 B). By fixing the name *indiana* to the Alaskan species, I stress the importance of chaetotaxy above the character of the claw, which is variable anyway.

Distribution and ecology

The species has a largly Beringian/Pacific distribution in Alaska. Only one inland record. *Central* (Fairbanks), *Aleutian Chain* (Buldir, Adak, Akun, Semidi Isls.), *SE Coast* (Juneau). The Aleut specimens were collected in various meadows, the Juneau specimens came from snow bed meadow (3,200 ft) and the single inland record was made under bark on black spruce. Specimens of this form are also present in samples from the Colorado Front Range. – *Total distribution:* Nearctic.

2. **Pseudachorutes** cf. **subcrassoides** Mills

Figs. 269–273.

Pseudachorutes subcrassoides Mills, 1934:24.

Description

Colour dark bluish-gray.

Size 1.8 mm.

Head. PAO with 11–14 rather irregular lobes, much larger than an eye (Fig. 271). Labium and labrum not prolonged, the longest labial seta clearly bypass tip of labium (Fig. 269). No spinulae or papillae on labium. Maxilla styliform, with 2 small apical teeth. Mandible as Fig. 272. Chaetotaxy as Fig. 270. On head some additional setae are present in the d-row. Th.1 with 4+4 or 5+5 setae. Th.3 with m_3–m_4 present.

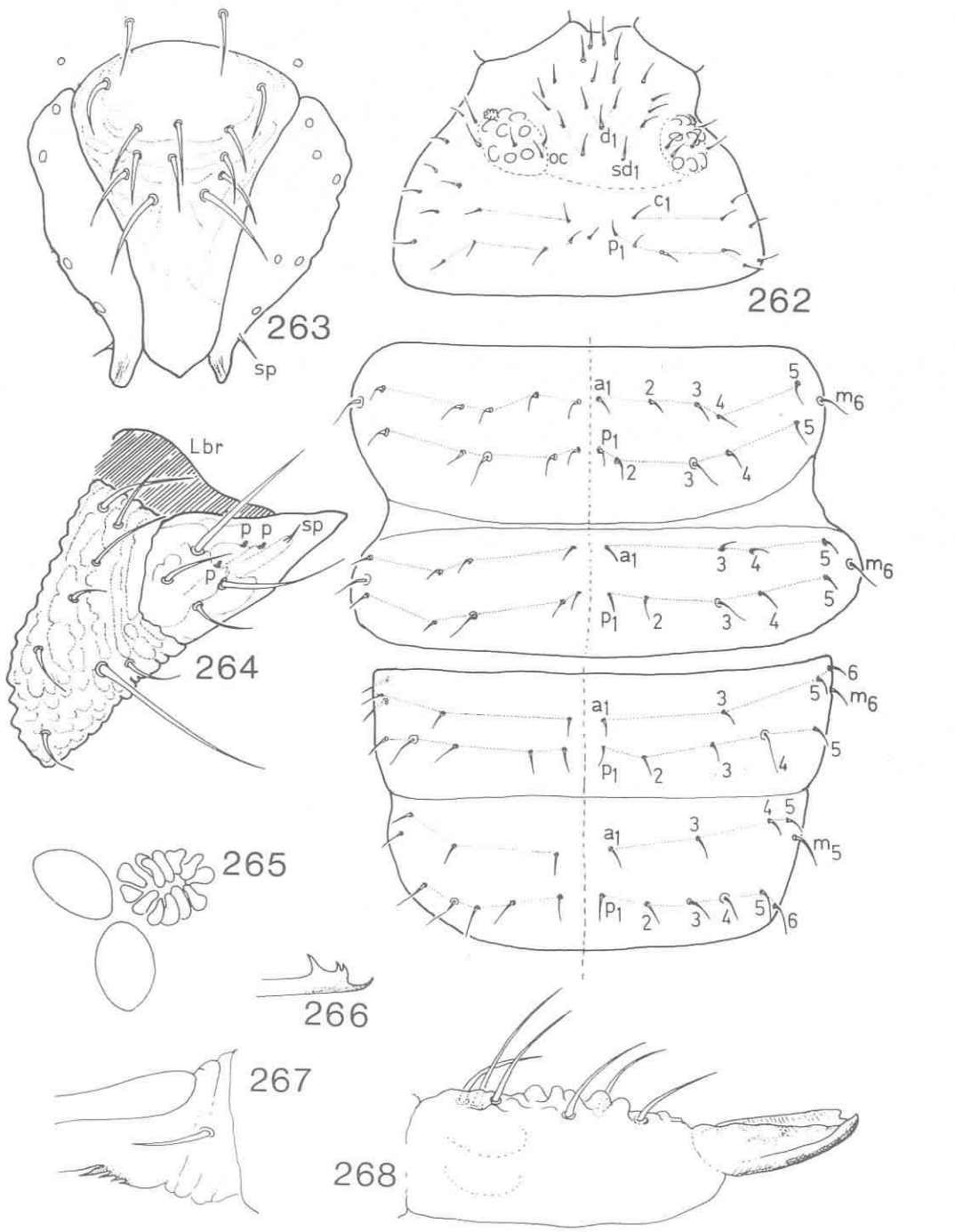
Body Abd.1-3 with two a-setae (a_3–a_4) in front of p_3–p_4, m_3 present. Individual variation frequent, especially on head and in the m-group in front of sensilla p_3 on Th.2–3. Ventral tube with 5+5 (4) setae. Furca short, dens plump, mucro with hooked tip (Fig. 273). Body granulation finer than in previous species.

Discussion

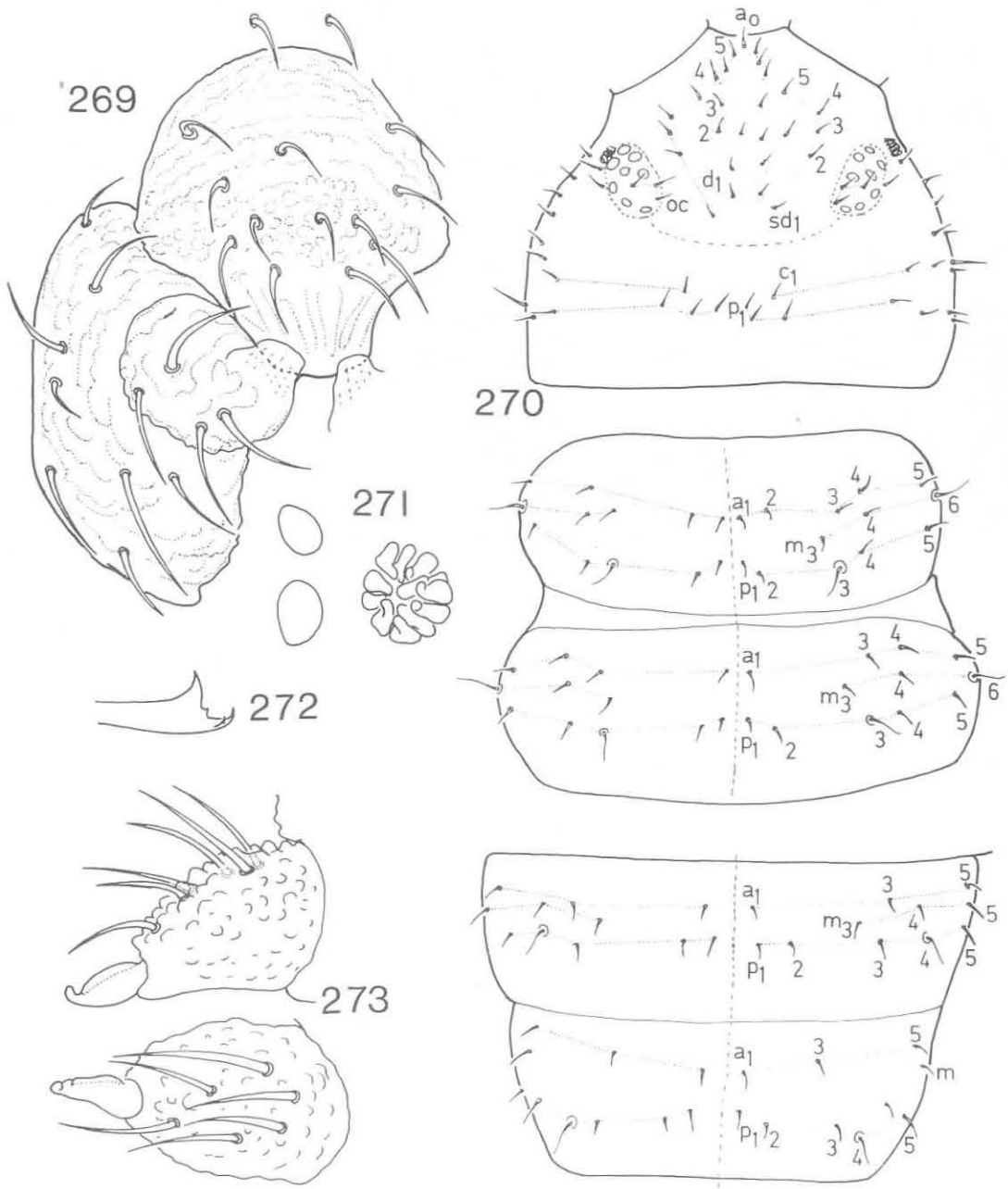
The identity of the Alaskan species is obscure. Following Christiansen & Bellinger (1980) it will key to *subcrassoides*. However, the chaetotaxy differs from their figure which shows a reduced m-row on Th.2–Abd.3 (like in *indiana*). The Alaskan form has a chaetotaxy like their figure of *texensis* which belongs to a different subgenus.

Distribution and ecology

Probably present over most of Alska. *N. Slope* (Meade River, Sagwon Upland), *Brooks Range* (mt. W of Atigun Camp, "Last Spruce" S of Chandalar), *Central* (Fairbanks area – many records, Mastodon Dome, Eagle Creek, Twelve Mile Mt.), *Alaska Range* (McKinley Park W of Wonder Lake Camp, Talkeetna Mts.), *Bering Area* (Kotzebue), *Aleutian Chain* (Amchitka). In the arctic/alpine tundra the species was found in bogs, meadows and alder/willow litter. In the Fairbanks area it is common in thick litter deposits in mixed taiga. Specimens of this form are also present in samples from the Colorado Front Range. – *Total distribution*: Nearctic



Figs. 262–268. *Pseudachorutes* cf. *indiana*. — 262. Chaetotaxy of head, Th.2–3 & Abd.3–4. — 263. Labrum & Labium, frontal view. — 264. Labium, lateral. p: Papillula. sp: Spinule. Lbr: Labrum. — 265. Right PAO. — 266. Mandible. — 267. Base of claw 3. — 268. Right dens & mucro.



Figs. 269–273. *Pseudachorutes* cf. *subcrassoides*. — 269. Labrum and labium, frontal view. — 270. Chaetotaxy of head, Th.2–3 & Abd.3–4. — 271. Right PAO. — 272. Mandible. — 273. Dens & mucro.

4.5.3 Genus *Pratanurida* Rusek, 1973

Type species: *Pratanurida cassagnaui* Rusek, 1973

This genus is based on two European species: *P. cassagnui* Rusek, 1973 from Czechoslovakia and Germany, and *P. mucronata* (Ellis, 1976) from Crete.

The full set of eyes and the styliform maxilla makes *Pratanurida* very similar to *Pseudachoutes*, though it is characterised by the reduced furca. Ellis (1976) however, pointed to the tendency of furca reduction seen in *Pseudachoutes boerneri* Schött, and gave *Pratanurida* subgeneric rank within *Pseudachoutes*.

The discovery of two new *Pratanurida* from Alaska, of which one has lost furca completely makes the delimitation of the group even more difficult. With regard to development of furca, there is apparently a continuum in full-eyed species from *Pseudachorutes* via *Pratanurida* to *Micranurida*. One single character seems to set off the classical *Micranurida* from the rest of the line: Absence of a_2 on Th.2. That seta is also absent in all *Anurida* s.str. examined so far. At the *Pseudachorutes* end of the line, a_2 may be present or absent, depending on species. The 4 known *Pratanurida* all have a_2 present.

The monotypic genus *Protachorutes* Cassagnau, with the Pyrenean species *P. pyrenaeus* Cassagnau, 1955, is similar to *Pratanurida* except for its "neanuroide" reticulation on head and tergites. I have examined recent material from Ariège, France (coll. Deharveng), and find the reticulation to be quite variable. In some individuals there is hardly any reticulation, only fields with slightly enlarged granules. I believe the reticulation is of no great significance. It is also more or less developed in the species *Anurida beringi* n.sp., *Willemia denisi* and certain *Paranura*. However, the labium of *Protachorutes* is quite special, exactly as here figured for *Pseudachorutes* cf. *indiana* (Fig. 264). This may indicate a strong connection between *Protachorutes* and some groups of *Pseudachorutes*. Also *P. pyrenaeus* has a_2 present on Th.2.

The genus *Stachorutes*, created by Dallai (1973) for the Italian species *S. demattisei* Dallai, has also a_2 present and is similar to *Pratanurida* except for the reduced number of eyes (2+2). At present it is difficult to evaluate the significance of eye number. Within both *Micranurida* and *Anurida* eye number varies from 0 to 8, though it is strongly felt that both these taxa are polyphyletic groups gathering the end points (furca absent) of several convergent lines. However, in some very tight groups like the *Anurida hammerae* group, eye number is notoriously variable. I therefore think there is no great evolutionary gap between *Pratanurida* and *Stachorutes*. The overall similarity indicates they are members of the same genus.

To make matters even more complicated, I will mention the existence in the Coloredo Front Range of a species having 3–5 ocelli (variable), styliform maxilla, well developed furca and reduced pigmentation. On Th.2 a_2 is present. In order not to break down the existing classification without providing a better one, the species is tentatively placed in *Stachorutes*, although it appears to be a straightforward derivative (reduced eye number) of *Pseudachorutes*. (Fjellberg 1984a) A generic classification coping with this intricate diversity of nature, is apparently some way off in the future.

As a conclusion, I give the following definition of essential characters of *Pratanurida*: 8+8 ocelli, maxilla styliform, tenaculum and furca either present or absent but dens and mucro always much reduced. Th.2 with seta a_2 present. Labium without sensorial papillae or spinulae (not checked in the European species).

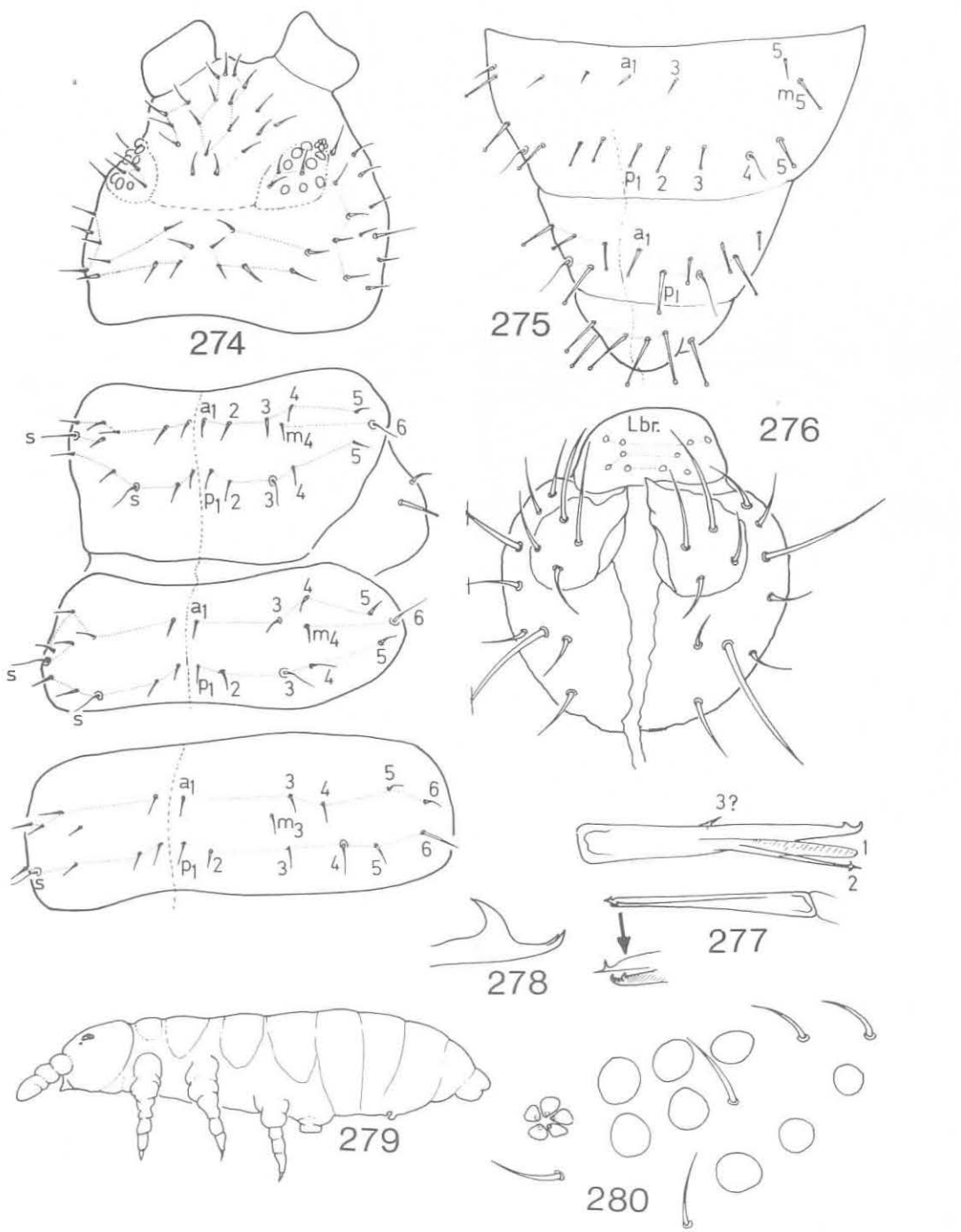
1. **Pratanurida tananensis** n.sp.

Figs. 274–282.

Type locality: Alaska. Bonanza Creek Experimental Forest at Fairbanks.
Type material: Holotype: One specimen (alc.) from "Alaska. Fairbanks. Bonanza Exp. Forest. 16.VIII.1980. Moss in white spruce forest. A.Fjellberg leg.", at USNM. – *Paratypes:* 16 from the holotype series deposited as follows: 11 (9 alc., 2 slide) at USNM, 2 (slide) at BM, 3 (slide) at AF. 1(slide) as above except "8.VIII.1980. Alder litter", at USNM. 1 (slide) from "Alaska. Golddust Creek at Mastodon Dome, 26.VII.1980. Litter, subalpine spruce stand. A.Fjellberg leg.", at USNM. 2 (slide) from "Alaska. Finger Mts. S of Old Man Camp, 21.VIII.1976. Dry moss and lichens on exposed boulders. A.Fjellberg leg.", at USNM.
Derivation of name: After the river Tanana, tributary to the Yukon, draining the Fairbanks area of Central Alaska.

Description

Colour spotted bluish-gray.
Size 1.1 mm.
Head. Ant.4 with a simple apical bulb on a long,



Figs. 274–280. *Pratanurida tananensis* n.sp. — 274. Chaetotaxy of head, Th.2–3 & Abd.2. — 275. Chaetotaxy of Abd.4–6. — 276. Labium, ventral. Lbr: Labrum. — 277. Maxilla. — 278. Mandible. — 279. General body shape. — 280. Left PAO & ocelli.

deeply embedded stalk. All 6 blunt sensillae subequal (as Fig. 285). Head with 8+8 ocelli. PAO with 5 (4–6) lobes, roundish, about the size of an eye (Fig. 280). Labrum with 4–4–2 setae. The 2 central setae apparently absent (Fig. 276). Labium with 8 setae in basal part, 4 (3) in apical part. Sensorial papillae absent (Fig. 276). Mandible with an apical two-split hook and a broad, membraneous basal tooth (Fig. 278). Maxilla styliform. Capitulum with 2 small apical teeth. Ventral side with one lamella (lam.2) reaching tip of capitulum, at apex with 2–3 fine teeth. Adpressed to lam.2 is the membraneous, toothless lam.1. A small spine-like structure on the dorsal side may represent lam.3 (Fig. 277)

Body granulation fine, uniform. Body hairs short, smooth. Macrochaetae on abdomen and subcoxae distinctly knobbed. On the last two abdominal segments all setae (except the sensillae) knobbed. Chaetotaxy as Figs. 274, 275. Head with 2+2 setae along ventral line. No ventral setae on thorax. Th.1 with 3+3 dorsal setae. Th.2 with complete a-row, a_2 present. The group a_3–a_4–m_4 rather variable, one seta often missing. Th.3 as Th.2, though a_2 generally absent (seen on one side in 1 of 7 specimens). Abd.1–3 often with one seta missing in the group a_3–a_4–m_3. Abd.4 with complete p-row, 3+3 setae between the sensillae. Only 2+2 a-setae inside the sensillae. Abd.5 with 2+2 a-setae inside the sensillae p_2. Ventral tube with 4+4 (5) setae. Furca partly reduced, mucro absent. Dens with 5 (4–6) setae (Fig. 281). Tenaculum with 2+2 (3) teeth. Tibiotarsi with one thick, strongly clavate tenent hair. Most of the other apical hairs also more or less clavate, especially the two dorsal ones behind the main hair (x–x in Fig. 282). Claws with a minute tooth about 1/4 from apex.

Discussion

The species could be confused with *Anurida bicolor* Christiansen & Bellinger which also has 8+8 ocelli and a similar furca and tenaculum. But *bicolor* has simple, acuminate body hairs. The position of *bicolor* is uncertain. Christiansen & Bellinger (1980) put it in *Protachorutes* which they treat as a subgenus of *Anurida*. Unfortunately the holotype of *bicolor* is badly squeezed and gives little information.

P. tananensis is separated from the following *foxi* n.sp. by the absence of furca and tenaculum in the latter.

Distribution and ecology

Only found in Central Alaska (see type material) in moss, lichens and forest litter. – *Total distribution*: Nearctic.

2. **Pratanurida foxi** n.sp.

Figs. 283–286.

Type locality:Alaska. Juneau. Mountains E of Montana Creek Trail, above Miners Cabin, 3,000 ft.
Type material: Holotype: Subadult female (slide) from "Alaska. Juneau. Mts. E of Montana Creek Trail. 14.VII.1980. In thick bark on subalpine hemlock, 3,000 ft. A.Fjellberg leg.", at USNM. – *Paratype:* (Allotype) Male (slide) as above, at USNM.
Derivation of name: Named after Dr. Joe Fox who operated the small field station that was my base camp while I collected in the Juneau mountains.

Description

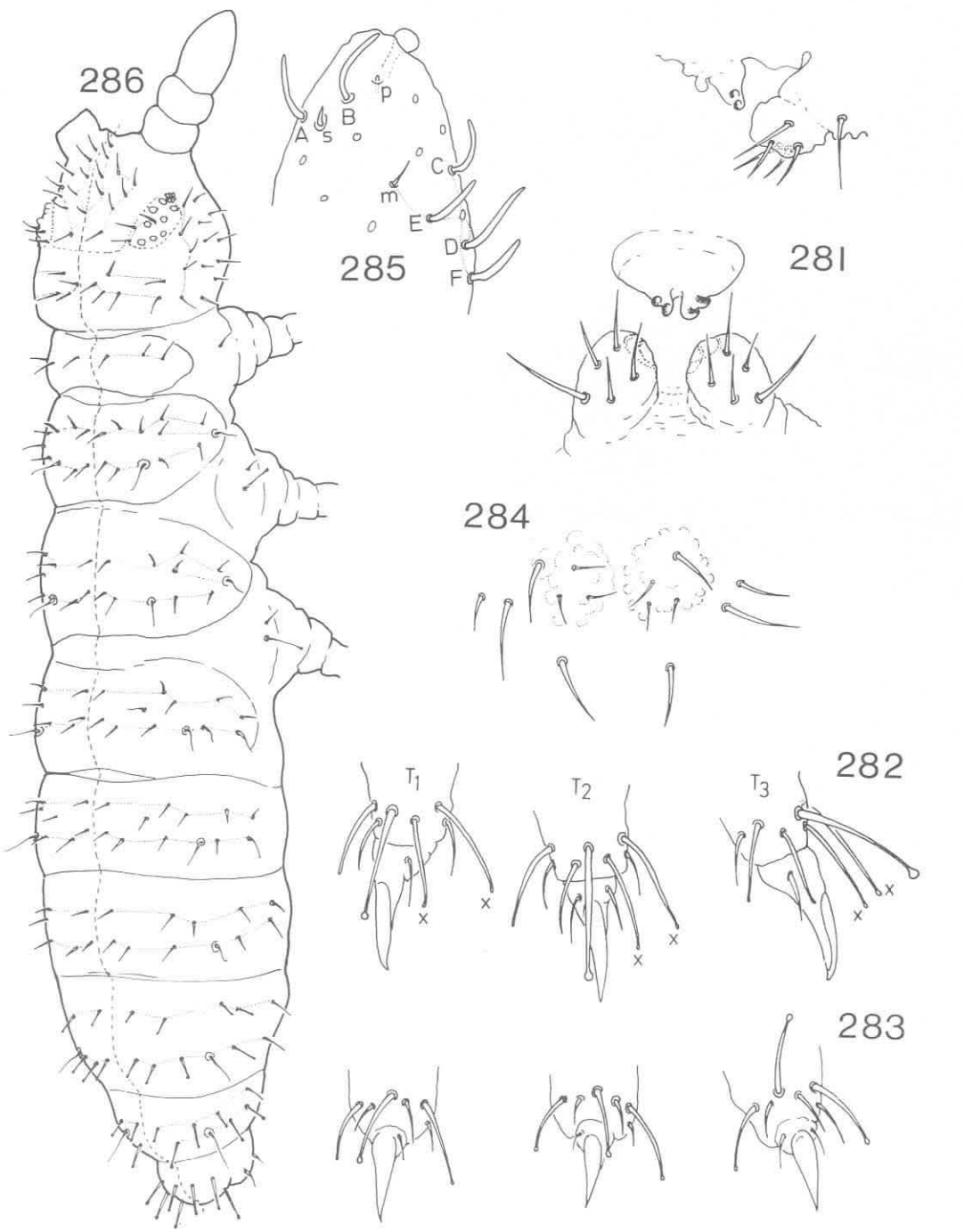
Colour spotted bluish-gray.
Size 1.0 mm.
Head. Ant.4 as Fig. 285. Chaetotaxy and general morphology as Fig. 286. Furca reduced to 2 small groups of 3+3 setulae (Fig. 284). No traces of tenaculum. Tibiotarsal tenent hairs clavate but less developed than in previous species (Fig. 283).

Discussion

The species is a perfect morphological replicate of *tananensis* apart from absence of furca/tenaculum and slightly less developed tenent hairs. Future studies may perhaps show that the two forms are in fact members of the same species. In any case they should be kept in the same genus/subgenus, which necessitates a redefinition of *Pratanurida* to include species without furca. Following traditional systematics, *foxi* would be classified as *Micranurida* but the presence of seta a_2 on Th.2 separates it from *Micranurida*.

Distribution and ecology

Only two specimens were found among thick, fluffy bark scales on live hemlock in a subalpine stand (3,000 ft) near Juneau, SE Alaska. A few more specimens appeared on hemlock at Garibal-



Figs. 281–286. — 281–282. *Pratanurida tananensis* n.sp. — 281. Furca & tenaculum. Lateral and ventral. — 282. Tenent hairs of T.1–3. — 283–286. *Pratanurida foxi* n.sp. — 283. Tenent hairs on T.1–3. — 284. Furca region, ventral. — 285. Sensillae of left Ant.4. — 286. General view, holotype.

di Lake, British Columbia (2.IX.1983, A.Fjellberg leg.).

4.5.4 Genus *Micranurida* Börner, 1901

Type species: *Micranurida pygmaea* Börner, 1901

The validity of the taxon *Micranurida*, either as genus or subgenus of *Anurida*, rests on *pygmaea*, the type species of the group. According to present opinion (Massoud 1967, Christiansen & Bellinger 1980), *Micranurida* differs from *Anurida* by the styliform maxilla without dentate or fringed lamellae. However, careful studies of *pygmaea* show that the maxilla has at least two dentate lamellae (Fig. 288). The inner ventral lamella (lam.2) has 2–3 serrations at tip. The outer ventral lamella (lam.1) is not seen, but may have been overlooked in the tiny *pygmaea* as it is notoriously difficult to detect even in some *Anurida*. The dorsal lamella (lam.3) is of the same bidentate type as in several *Anurida*. Apart from the generally more elongate shape of the maxilla in *Micranurida*, there is no principal difference separating it from *Anurida*.

Key

1. Eyes absent. Sensilla m_6 on Th.2 and p_4 on Abd.4 globular (Fig. 293) ..... 2. *spirillifera*
– Eyes present. Sensillae hair-like, slender 2
2. Head with 1–2 ocelli 3
– Head with 5+5 ocelli ..... 4. *porcella* n.sp.
3. Body with fields of coarse granulation (Fig. 294). Ant.4 sensillae slender (Fig. 297). 1+1 ocelli .... 3. *valiana* n.sp.
– Body granulation uniform. Ant.4 sensillae swollen (Fig. 290). 2+2 ocelli ..... 1. *pygmaea*

1. **Micranurida pygmaea** Börner

Figs. 287–290.

Micranurida pygmaea Börner, 1901:702.

Description

Colour spotted bluish-gray of variable intensity, sometimes nearly white. Eyes usually singly pigmented.

Size 0.5 mm.

Head. Ant.4 with 5 short, thick sensillae, E absent (Fig. 290). Manible as Fig. 289. Sometimes the small apical tooth and the anterior of the 2 basal teeth may be absent or reduced. Maxilla as Fig. 288. Basal part of labium with 8 setae, apical part with 3–4 setae and no sensorial papillae. Ocelli 2+2.

Body chaetotaxy as Fig. 287. Head with 3+3 or 4+4 setae in the posteriomedian group. If 3+3, then either p_1 or p_2 absent. Th.1 with 2+2 setae. Th.2–3 with p_2 absent or present. Only 2 setae (a_3–a_4) in front of p_3–p_4. Abd.1–3 with p_2 present or absent. Only 1 seta (a_3) in front of p_3–p_4. Abd.4 with 2+2 p-setae between sensillae p_4 (p_2 absent). Seta a_2 usually absent.

Discussion

Alaskan specimens were compared with Norwegian samples and no clear differences were found. The above described variability in chaetotaxy is interesting and more detailed studies may show differences between populations to exist.

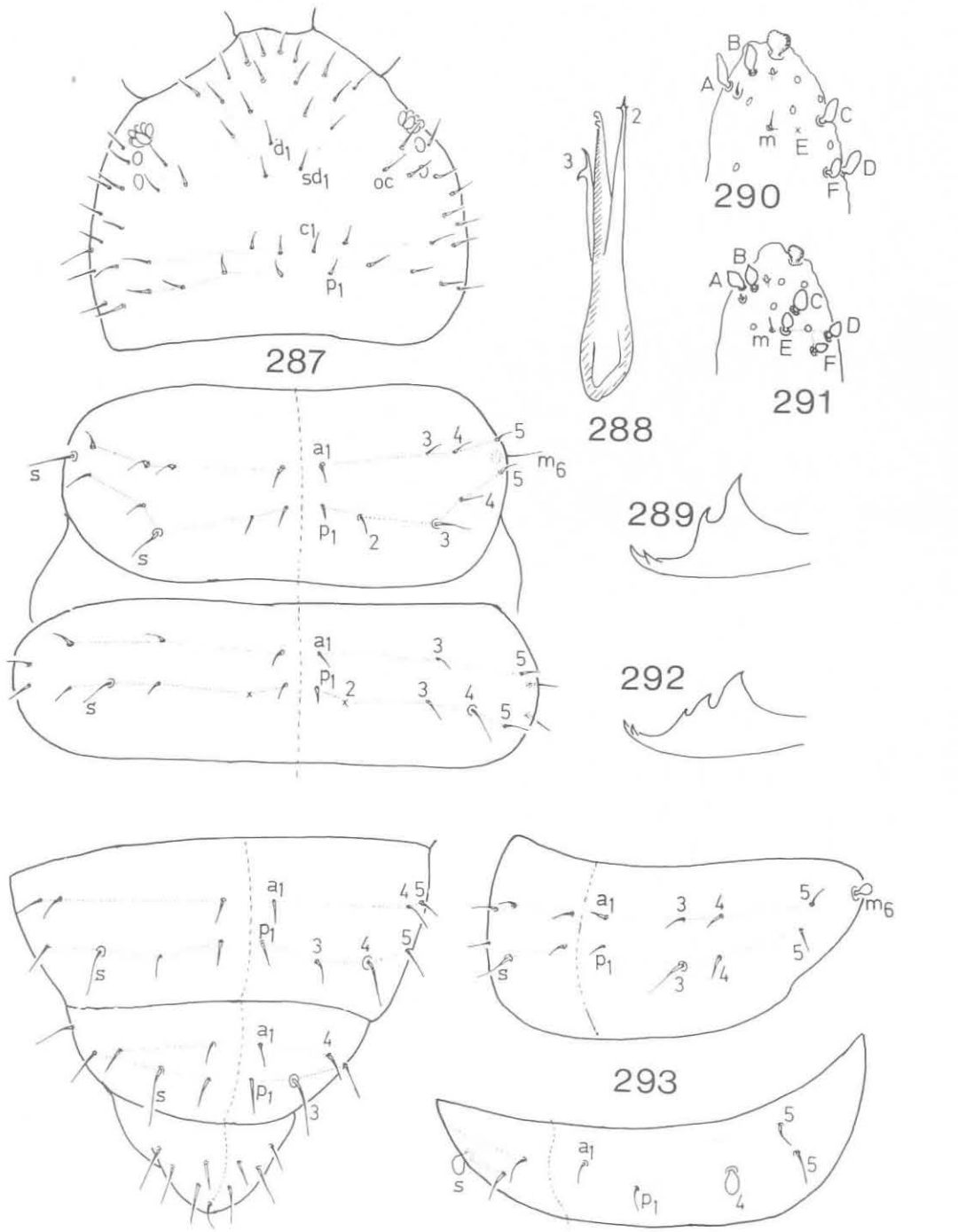
Distribution and ecology

Probably the most common and widespread of the Alaskan podurids. Found in all pricipal parts of Alaska. *N. Slope* (Icy Cape, Canning River Delta, Toolik Lake, Sagwon Upland, Franklin Bluffs, Meade River), *Brooks Range* (mts. W of Atigun Camp, mts. across Galbraith Lake Camp, Atigun River, "Last Spruce" S of Chandalar, Sukakpak Mt. S of Dietrich Camp), *Central* (many localities in the Fairbanks area, Gobbler Knob S of Prospect Camp, Finger Mts. S of Old Man Camp, Mastodon Dome, Eagle Creek), *Alaska Range* (McKinely Park, Denali Hwy. – several places, Richardson Hwy. at summit Lake, Flood Creek and Triangle Peak, Talkeetna Mts., Thompson Pass in Chugach Mts.), *Bering Area* (Kotzebue), *Aleutian Chain* (Buldir, Amchitka, Adak), *SE Coast* (Turnagain Pass on Kenai Pensinsula, Juneau – several localities). Common in litter in many different habitats up to above 6,000 ft, avoiding only the driest biotopes. – *Total distribution:* Holarctic.

2. **Micranurida spirillifera** Hammer

Figs. 291–293.

Micranurida spirillifera Hammer, 1953:25



Figs. 287–293. — 287–290. *Micranurida pygmaea*. — 287. Chaetotaxy of head, Th.3–Abd.1 & Abd.4–6. — 288. Maxilla. — 289. Mandible. — 290. Left Ant.4. 291–293. *Micranurida spirillifera*. — 291. Left Ant.4. — 292. Mandible. — 293. Th.2 & Abd.4

Description

Colour white.

Size 0.5 mm.

Head. Ant.4 with simple or weakly lobed apical bulb. All 6 sensillae present, globular (Fig. 291). Head without ocelli. PAO with 7–9 lobes. Mandible with 2 apical and 3 basal teeth. Maxilla as in *pygmaea* (Fig. 288). Chaetotaxy principally like *pygmaea*, but p_2 always (?) absent on Th.2–Abd.3 and Abd.4 has only 1+1 p-setae between the sensillae (Fig. 293). The median pair of p-setae on Abd.4 probably represent p_1 which are laterally displaced. In some specimens a_1–p_1–p_4 are set in a single transverse row. Lateral sensilla (m_6) on Th.2 globular, on Th.3 normal. Also p_4 on Abd.4 swollen, normal on other tergites. Abd.5 without a_1. Furca region with a few setulae.

Discussion

The species resemble *pygmaea*, but readily differs by lack of eyes and notably by the swollen sensillae on Th.2 and Abd.4. These sensillae are not mentioned by Hammer (1953) in the original description. I have examined two syntypes labelled "Type. Collembola. Canada 1948. Yellow Knife 384. Micranurida spirillifera n.sp. M. Hammer", kept at Biosystematics Research Institute, Ottawa. Althoug few details were seen, the globular p_4 sensilla was visible on one side of Abd.4 in 1 specimen.

The unique globular sensillae are found in only two other species in the *Micranurida/Anurida* complex: *Anurida sensillata* Gisin (Switzerland, Germany, England) and *A. endroedii* Dunger (Hungary). The overall similarity between *endroedii* and *spirillifera* is striking. Chaetotaxy is idenical, notably absence of p_2 on Th.2–Abd.3 and absence of a_1 on Abd.5. The only clear differences are the shapes of mandible and maxilla. *A. endroedii* has only one maxillary lamella which has many small denticles while *A.sensillata* has a less reduced chaetotaxy with p_2 present on Th.2–3 (absent on Abd.1–3) and a_1 present on Abd.5. Dunger (1974) also described a German subspecies of *sensillata*, ssp. *latosensillata*, differing form the nominal form by details of Ant.4 sensillae, PAO and maxilla which is similar to *endroedii* (the nominal form is said to have "gefransten Lamellen").

Unless there is an extreme case of convergent evolution, I see no reason to place *spirillifera* and *endroedii/sensillata* in different genera or subgenera. As there is no difference in maxilla of *spirillifera* and *pygmaea*, the type species of *Micranurida*, I transfer *endroedii/sensillata* to *Micranurida*. The 3 (?) species form a distinctive subgroup characterised by the combination of swollen Ant.4 sensillae and swollen sensillae on Th.2 and Abd.4.

Distribution and ecology

Only a few records from interior parts of Alaska. *Brooks Range* (Sukakpak Mt. S of Dietrich Camp), *Central* (Eagle Creek at Mastodon Dome), *Alaska Range* (Denali Hwy. 30 mi from Paxson). Collected in alpine, dry meadows and in willow litter along creeks. – *Total distribution*: Nearctic.

3. **Micranurida valiana** n.sp.

Figs. 294–299.

Type locality: Inner part of Golddust Creek (tributary to Eagle creek) at Mastodon Dome NE of Fairbanks (Steese Hwy.).

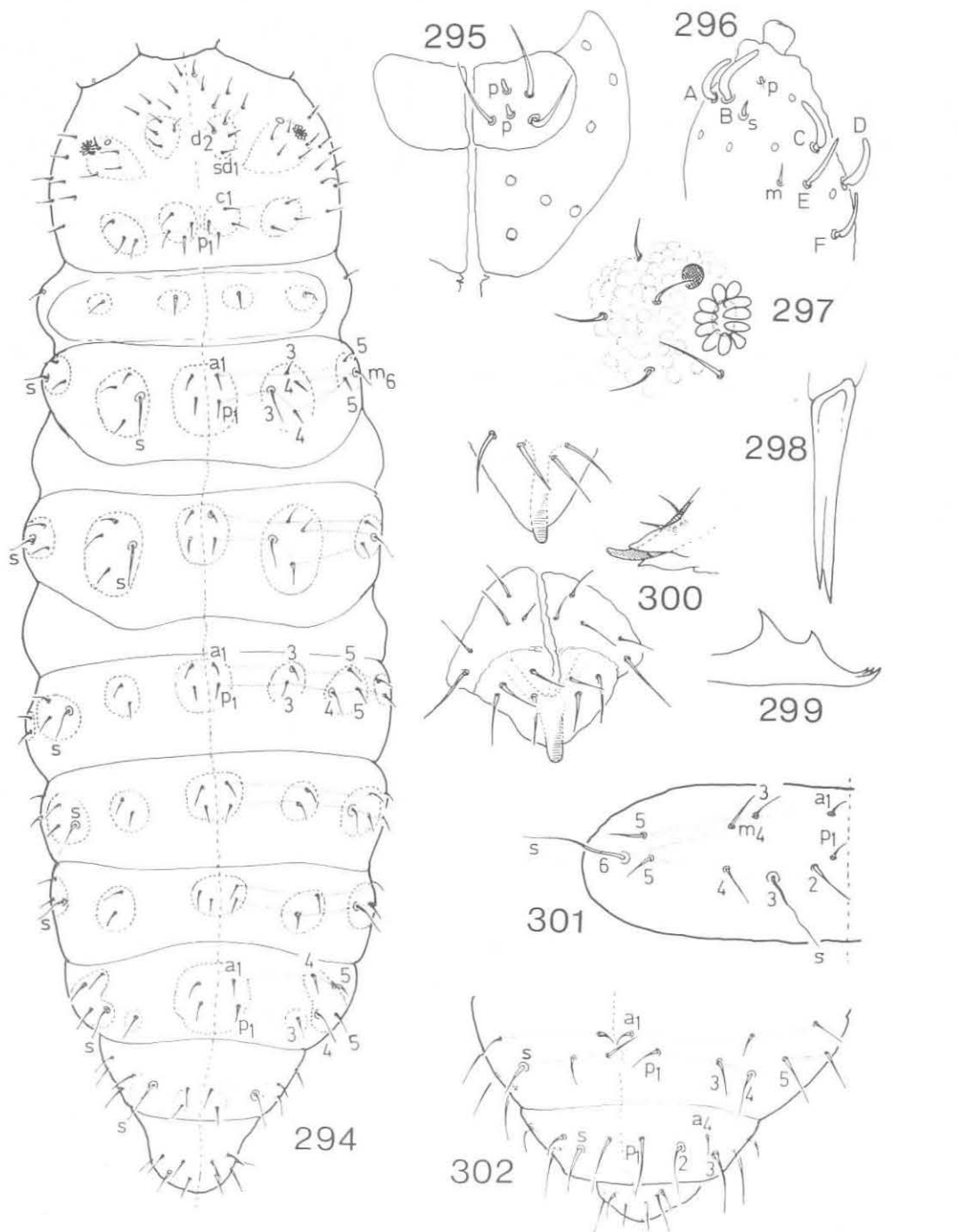
Type material: Holotype: One specimen (alc.) from "Alaska. Mastodon Dome, NE Fairbanks. 26.VII.1980. Willow litter along Golddust Creek. A.Fjellberg leg.", at USNM. – *Paratypes:* 4 (alc.) as above, at USNM. 2 (alc.) from "Alaska. Twelve Mile Mt., Steese Hwy. 27.VII.1980: Frost boil polygon in meadow among willow thickets. A.Fjellberg leg", at USNM. 1 (slide) from "Alaska. Eagle Creek at Mastodon Dome NE Fairbanks. 27.VII.1980. Willow litter. A.Fjellberg leg", at USNM. 1 (slide) from "Alaska. Fairbanks, 23.VII.1980. Willow and birch litter in bog at W side of Smith Lake. A.Fjellberg leg.", at MCZ. 2 (alc.) from "Alaska Range. Clearwater Mts. E of Susitna Lodge. 30.VII.1980. Wet meadow, snow-bed. 5,000 ft. A.Fjellberg leg.", at USNM. 1(slide) as above, at BM. 1 (slide) as above except "Wet moss at foot of talus, 5,000 ft.", at BM. 1 (alc.) from "Alaska. Happy Valley Cut S of Prudhoe Bay. 17.VIII.1976. Alder/willow litter. A.Fjellberg leg.", at USNM. 2 (slides) as above, except "Thick moist litter in dense stand of Alnus crispa", at AF. 1 (slide) as above, except "Birch litter. V. Behan leg.", at USNM. 1 (slide) from "Alaska. Talkeetna Mts., Watana Mt. 12.VIII.1980. Moss bed. S.F. Maclean leg.", at USNM.

Derivation of name: Named after Dr. Valerie (Val) M. Behan, whose pleasent company and acarological expertise was much appreciated during field work in Alaska and Chukotka.

Description

Colour white or slightly yellowish, the tiny eye spot dark blue.

Size 0.6 mm.



Figs. 294–302. — 294–299. *Micranurida valiana* n.sp. — 294. Chaetotaxy. — 295. Labium. p: Papilla. — 296. Left Ant.4 sensillae. — 297. PAO and eye. — 298. Maxilla. — 299. Mandible. — 300-302. *Micranurida furcifera*. — 300. Labrum. Dorsal, lateral and ventral. — 301. Th.3, left side. — 302. Abd.4–6.

Head. Ant.4 with 6 blunt sensillae, E and F thinner than other (Fig. 296). Head with 1+1 small ocelli. PAO with 10–13 lobes, slightly oval (Fig. 297). Apical part of labium with 3 setae and 2 small sensorial papillae (Fig. 295). Mandible with 3 small apical teeth and 2 broad basal teeth (Fig. 299). Maxilla styliform with at least 1 pointed lamella. No teeth observed (Fig. 298).

Body with coarse granulation arranged in raised fields. Chaetotaxy as Fig. 294. Th.2–Abd.3 without seta p_2. Th.2–3 with sensilla p_3 in forward position, in front of p_1–p_4. Furca region with a few setulae. Claws simple, without teeth. Tenent hairs short, acuminate.

Discussion

Apart from presence of eyes – which could easily be overlooked – the species resembles the poorly described *Micranurida furcifera* Mills from Connecticut and Iowa. A slide with 4 "cotypes" marked "Cotypes. Micranurida furcifera Mills. Ames, IA. Aug.28.1932. Det. H.B. Mills" (Dept. of Entomology. Iowa state Univ., Ames) was examined. A few important details could be seen: Integument is uniform, without raised fields. Th.2–3 chaetotaxy as Fig. 301, p_2 is present and sensilla p_3 is in backward position. Abd.4–6 as Fig. 302. Abd.5 possibly without a_1, but this seta may have been hidden among wrinkles in anterior part of the tergite. Furca fairly long, like a projecting papilla with 6 setae. Maxilla appears styliform. Labrum snout-like prolonged, apex upturned (Fig. 300). Ocelli could not be seen. *M. furcifera* appears to be a well marked species, quite different from *valiana*.

The raised cuticular fields in *valiana* resemble those of the European species *forsslundi* Gisin and *anophthalmica* Stach, which are both eyeless.

Distribution and ecology

Probably distributed over most of Alaska. *North Slope, Central, Alaska Range* (see type material). Most records are from damp litter in thickets of willow, birch and alder. Also in lush, low-alpine meadows. – *Total distribution*: Nearctic.

4. **Micranurida porcella** n.sp.

Figs. 303–309.

Type locality: Alaska. Bonanza Creek Exp. Forest at Fairbanks.
Type material: Holotype: One specimen (alc.) from "Alaska. Bonanza Creek Exp. Forest, Fairbanks. 16.VIII.1980. Moss in white spruce forest. A.Fjellberg leg.", at USNM. – *Paratypes:* From the holotype sample, 63 (60 alc., 3 slide) at USNM, 4 (slide) at MCZ, 2 (slide) at BM and 7 (slides) at AF. 7 (alc.) as above, except "10.VIII.1980. Moss in paper birch forest", at USNM. 16 (alc.) as above, except "8.VIII.1980. Moss in white spruce forest", at USNM. 6 (alc.) as above, except "Litter in alder shrubs", at USNM.
Derivation of name: During the first, rough sorting of the samples, this species was mentally fixed by thinking of a small fat pig. Thus the name *porcella*.

Description

Colour spotted gray, varying from pale to rather dark. Unlike most other species, the pigment is more pure gray or black rather than blue or violet.

Size 0.7 mm.

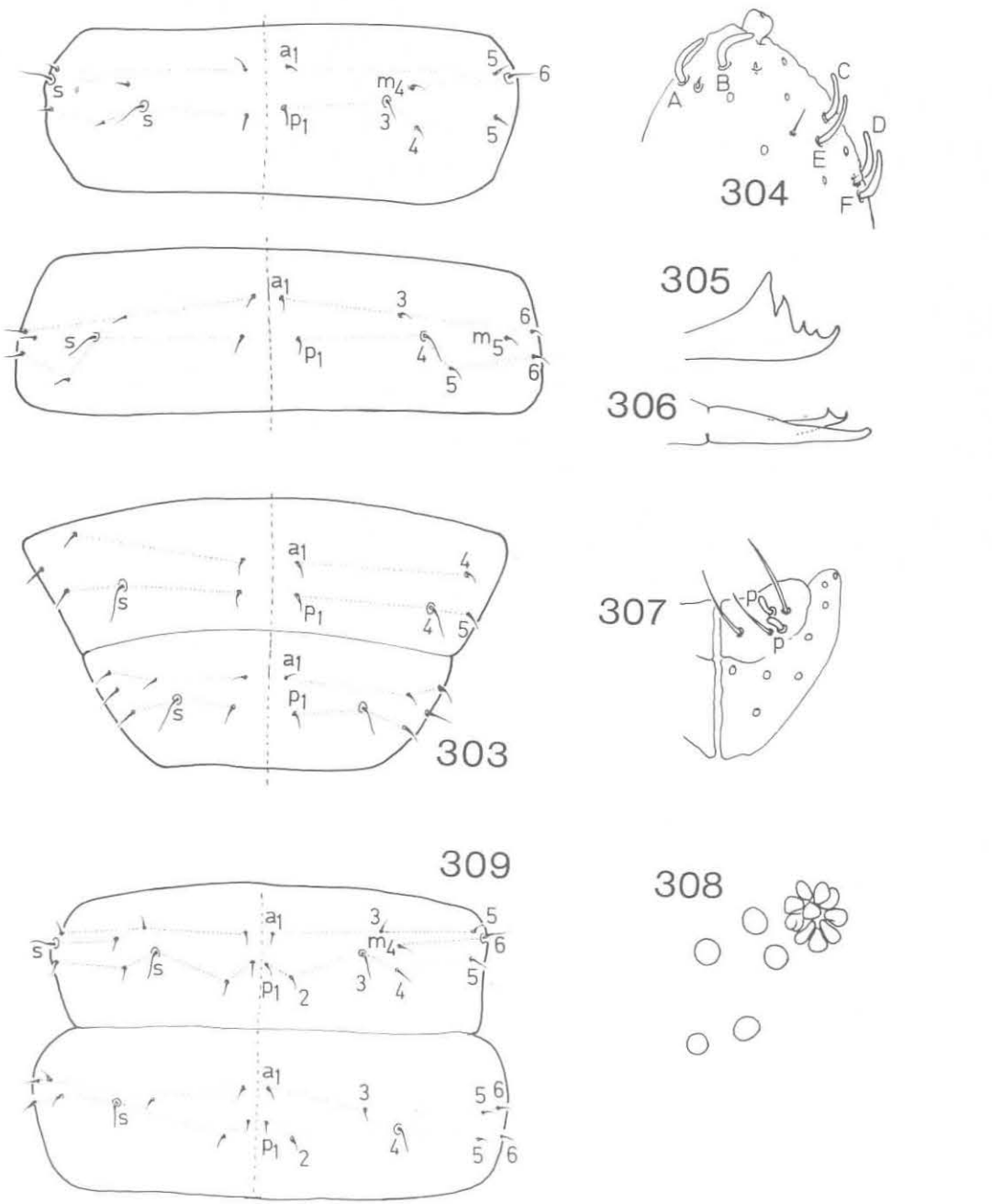
Head. Ant.4 with 6 subequal, blunt sensillae (Fig. 304). Apical bulb weakly 3-lobed. The large ventral sensilla of Ant.3 organ only moderately curved. Head with 5+5 ocelli (Fig. 308). PAO with 8–12 lobes, roundish. A central lobe is often present (Fig. 308). Mandible with 3+2 teeth (Fig. 305). Maxilla styliform, blunt-tipped, with a bidentate dorsal lamella (lam.3, Fig. 306). Apical part of labium with 3 setae and 2 fairly large sensorial papillae (Fig. 307).

Body granulation moderately coarse, uniform. Body hairs very short, thin. Chaetotaxy as Fig. 303. On head 1 or 2 additional setae often present in the d-row, but this is a very variable character. Th.1 with 3+3 setae. Th.2–3 without p_2. Sensilla p_3 in forward position. Abd.1–4 without p_2 and p_3. Sometimes a_3 absent on Abd.1–3. Abd.4 with 1+1 p-setae between sensillae p_4. Furca reduced, indicated by 2 minute warts. Ventral tube with 4+4 setae. Claws simple, without teeth. Tenent hairs acuminate.

A small, stout grub-like species.

Discussion

The presence of 5+5 ocelli readily separates this species from other Nearctic *Micranurida*. The European species *peyrei* (Cassagnau), now placed



Figs. 303–309. *Micranurida porcella* n.sp. — 303. Chaetotaxy of Th.2, Abd.1 & Abd.4–5. — 304. Left Ant.4 — 305. Mandible. — 306. Maxilla. — 307. Labium. — 308. Right PAO and ocelli. — 309. Chaetotaxy of Th.3–Abd.1 of a specimen from Delta.

in the genus *Rusekella* (Deharveng 1982), also has 5+5 ocelli but differs from *porcella* in having a_2 present on Th.2 and sensilla p_3 in backward position on Th.2–3 (observed in recent material colletced in Ariège, coll. Deharveng).

Chaetotaxy of *porcella* is characterized by the reduced p-row of Abd.1–4. Other Nearctic *Micranurida* at least have p_3 present on Abd.1–3.

Distribution and ecology

Known only from the Fairbanks area in Central Alaska. In moss and litter in both hardwood and coniferous taiga. Once under bark on a fallen aspen. – *Total distribution*: Nearctic.

Note

A few specimens from near Delta (mi 287–289 at Richardson Hwy.) may represent a different species. Chaetotaxy is less reduced (Fig. 309). On Th.2–3 a_3 and p_2 are present, on Abd.1–4 p_2 is present. Also the 4 setae in the lateral group outside p_4 on Abd.1–3 are slightly differently arranged, – notably p_5 which is moved away from p_4. These specimens appeared in dry litter of *Juniperus*, *Rosa* and a bushy *Artemisia* growing in exposed loess slopes above the road.

4.5.5 Genus *Anurida* Laboulbène, 1865

Type species: *Anoura granaria* Nicolet, 1847

Chaetotaxy is important in species identification in this genus. In a separate paper I have outlined the chaetotaxy patterns in *Anurida* and related genera (Fjellberg 1984c).

Also the maxilla offers good characters. All species examined so far have a capitulum with two ventral lamellae (lam.1 & 2) and one dorsal (lam.3, Fig. 313).

Deharveng (1981) has formalised a system for distibution of Ant.4 sensillae in Neanurinae. In the *Anurida* complex the situation is slightly simpler, but with more interspecific variation. Primarily six blunt sensillae are present (Deharveng's nomenclature in parenthesis, Fig. 322): A (s_8), B (s_7), C (s_4), D (s_3), E (s_2) and F (s_1). A & B are dorsoexternal, C, D, E & F are dorsointernal making up a cross centered around a simple macrochaeta. The line D–E terminates in a microchaeta, m (soie ordinaire mediane, i). Behind A-B is a small spine-like sensilla, s (microsensille externe, se). Between B and the apical bulb is a small sensorial papilla, p (organite, or), from which a fine tubule penetrates the antennal body. One or more additional sensillae, x, may be present behind A–B (Fig. 319). Frequently E & F are thinner than the others or one of them is absent (Fig. 312).

The Alaskan *Anurida* fauna has proved very rich with no less than 8 new species, increasing the number of Nearctic species from 10 to 18 (Christiansen & Bellinger 1980). Other undescribed species are seen in materials from adjoining parts of NE Siberia, indicating that this part of the Arctic has been a very prosperous ground for differentiation of the genus.

Key

1. Ocelli present 2
– Ocelli absent 10
2. Mandible with 10 or more teeth. PAO with 30–40 lobes ..... 1. *amorita*
– Less than 10 mandibular teeth, less than 30 PAO lobes 3
3. Th.1 with many setae in more than 1 row ..... 11. *hammerae*
– Th.1 at most with 4+4 setae in 1 row 4
4. 5+5 ocelli 5
– 4+4 or 3+3 ocelli 6
5. Th.2–3 with p_2 in front of p_1, a_3 & m_4 present (Fig. 355). Max.lam.1 sagittate (Fig. 359). PAO with 25 or more lobes ..... 12. *beringi* n.sp.
– Th.2–3 with p_2 behind p_1, a_3 & m_4 absent (Fig. 310). Max.lam.1 simple (Fig. 313). PAO usually with less than 10 lobes ..... 2. *decemoculata*
6. Th.2–3 with sensilla p_3 behind p_4 (Fig. 330) ..... 6. *papillosoides*
– Th.2–3 with p_3 in front of p_4 (Fig. 329) 7
7. Only 1 p-seta (p_2) in the axial group of Th.2–3 (as Fig. 374). Max.lam.3 sagittate (as Fig. 376) ..... 14. *narli* n.sp.
– Two p-setae (p_1–p_2) in the axial group of Th.2–3 (Fig.329). Max.lam.3 with 2 hooks (Fig. 325) ... 8
8. Th.1 with 4+4 setae. Subcoxa 1 usually with 5 setae, Abd.5 with p_2 ..... 5. *papillosa*
– Th.1 with 3+3 setae. Subcoxa 1 with 1–2 setae. Abd.5 without p_2 9
9. 4+4 ocelli. Ant.4 usually with 8 subequal sensillae, E & F not thinner than the others (Fig. 319). Dark species. ..... 3. *weberi*
– 3+3 ocelli. Ant.4 with 6 sensillae, E & E much thinner than the other (Fig. 322). Pale species ..... 4. *interior* n.sp.
10. Th. 2–3 with sensilla p_3 in front of p_4. Axial group with 1 p-seta (p_2, Fig. 374) ..... 13. *reducta* n.sp.
– Th.2–3 with p_3 at level with or behind p_4, axial group with 2 p-setae (p_1–p_2, Fig. 340) 11
11. Th.2–3 with p_2 behind p_1 (Fig. 340) 12
– Th.2–3 with p_2 in front of p_1 (Fig. 347) 13

12. Abd.4 with 1+1 setae between sensillae p_4 (Fig. 341). Ant.4 with 2 lateral sensillae (A & B, ... Fig.342) ..... 8. *subarctica* n.sp.
– Abd.4 with 3+3 setae between sensillae p_4 (Fig. 340). Ant.4 with 3 lateral sensillae (A, B, X, Fig. 336) ..... 7. *polaris*
13. Ant.4 with 2 lateral sensillae (A & B, Fig. 349). Max.lam.3 sagittate (Fig.351) .... 9. *martynovae* n.sp.
– Ant.4 with 3 lateral sensillae (A, B, X, Fig. 353). Max.lam.3 with 2 hooks and a small tooth (Fig. 352) ..... 10. *similis* n.sp.

1. **Anurida amorita** Folsom

Anurida amorita Folsom, 1902:90.

Description

Colour. Mottled dark blue.

Size.4.1 mm.

Head.PAO elongate, with 30–40 lobes. Maxilla with serrate/multidentate lamellae. Capitulum with large apical tooth followed by about 6 smaller teeth. Mandible multidentate, with about 12 teeth.

Discussion

The unique mandible, in combination with large size and strongly developed PAO, should make this species easily recognisable. Chaetotaxy is unknown.

Distribution and ecology

The species was originally descibed from Kukak Bay in Alaska (Folsom 1902). No further records are known, but Axelson (1903a) identified specimens from Sjigansk at Lena River (Jakutia) as *amorita*. – *Total distribution:* Nearctic (?Holarctic).

2. **Anurida decemoculata** Hammer

Figs. 310–314.

Anurida decemoculata Hammer, 1953:29.

Description

Colour bluish-black, very dark.

Size 1.1 mm.

Head. Ant.4 with 3-lobed apical bulb and 5–6 blunt sensillae. (Fig. 312). F slightly thinner than C & D, E generally absent. Ocelli 5+5 (4). PAO roundish, with 6–11 lobes (Fig. 311). Labrum and labium as in *papillosoides*, Fig. 335. Mandible with 4–5 apical teeth and 2 large basal teeth (Fig. 314). Maxillary capitulum with 3–4 teeth, lam.1 simple, lam.2–3 with rather few serrations (Fig. 313).

Body granulation rather coarse, hairs short and fine. Chaetotaxy as Fig. 310. Characterisics are: Th.1 with 3+3 setae, Th.2–3 with sensilla p_3 in front of p_4, Abd.1–4 with p_2 present, p_3 absent. Thus Abd.4 has only 2+2 p-setae between the sensillae p_4. Only 2 setae in front of p_4–p_5 (a_4–a_5). Furca region with 2 groups of 3–4 setulae. Tenacular field with 2 setae. Ventral tube with 4+4 setae. Claws with a distinct tooth at middle of inner edge. Tenent hairs acuminate.

Discussion

The identity of this species remains doubtful. The above description is based on Alaskan specimens. A slide with 2 type specimens labelled "Type. Collembola. Canada 1948. Reindeer St. 163. Anurida decemoculata n.sp. M. Hammer" (Biosystematics Research Institute, Ottawa) was examined. Unfortunately the specimens are very dark and shrunken and show no important details. The general inpression is that they are the same as the Alaskan species.

Specimens from Central Alaska are slightly smaller and paler than those from the North Slope, they also have the E sensilla present on Ant.4.

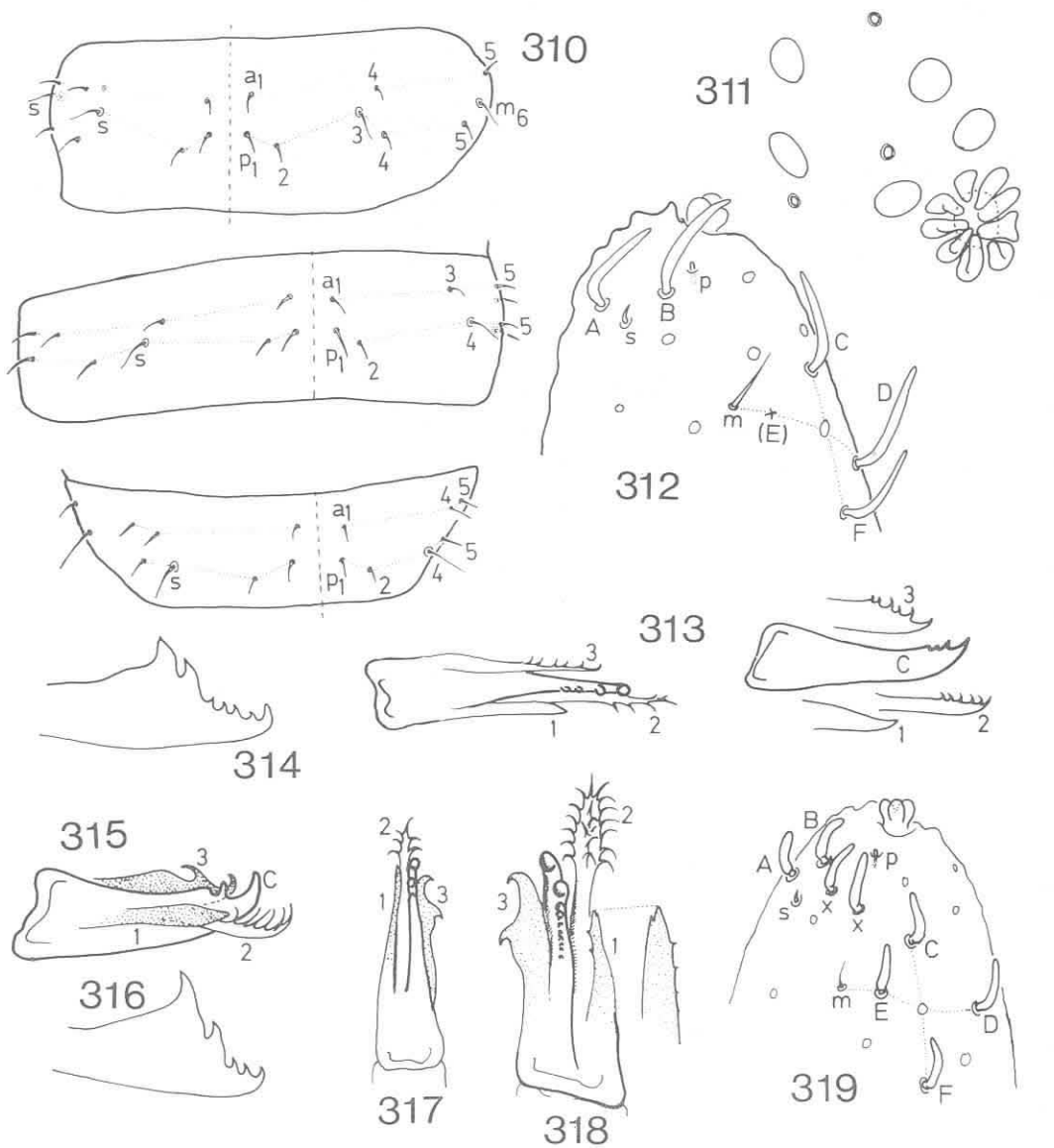
Distribution and ecology

Common on the *N. Slope* (Meade River – many records, Smith River at Lonely, Prudhoe Bay, Franklin Bluffs, Toolik Lake, Atigun River). Only few records from *Central Alaska* (Eagle Creek at Mastodon Dome, Ft. Yukon). Only found in damp places (willow litter along creeks, wet meadows, bogs, under stones on muddy river banks with *Dupontia*, moist polygon troughs, etc.). – *Total distribution*: Nearctic – E. Palearctic (Chukotka: Chaun Bay).

3. **Anurida weberi** Christiansen & Bellinger

Figs. 315–319.

Anurida weberi Christiansen & Bellinger, 1980:335.



Figs. 310–319. — 310–314. *Anurida decemoculata*. — 310. Chaetotaxy of Th.2, Abd.1 & Abd.4. — 311. Right PAO and ocelli. — 312. Left Ant.4. — 313. Maxilla. At right with separate lamellae. — 314. Mandible. — 315–319. *Anurida weberi*. — 315. Maxilla, paratype (Barrow). — 316. Mandible, paratype (Barrow). — 317. Maxilla, typical form. — 318. Maxilla, specimen from Pribilof Isls. — 319. Left Ant.4 sensillae.

Description

Colour bluish-gray, rather dark. Ventral side paler.

Size 1.5 mm.

Head. Ant.4 with 6 equally thick A–F sensillae. In addition 2 (rarely 1) extra X-sensillae are present between A–B and the dorsal cross-group (Fig. 319). Apical bulb 3-lobed. Ocelli 4+4. PAO roughly circular, with 12–17 lobes. Labium as Fig. 328. Mandible with 3+2 teeth (Fig. 316). Maxilla-

ry capitulum with strong apical and subapical teeth, often followed by some smaller teeth along the cutting edge. Lam.1 simple, smooth. Lam.2 passing tip of capitulum, with a few apical serrations. Lam.3 with 2 strong hooks (Fig. 317).

Body granulation rather coarse, hairs smooth and short. Characteristics of chaetotaxy: Th.1 with 3+3 setae. Th.2–3 as in *papillosa* (Fig. 329), with p_3 in front of p_4. Abd.1–3 as in Fig. 329. Abd.4 as in *interior*, Fig.320, with p_2 absent. Subcoxae with 1(2)–2(3)–2(3, 4) setae. Ventral tube with 4–5 setae on each side.

A large, broad species. In specimens preserved in alcohol, the small Abd.6 often hidden by the square Abd.5.

Discussion

The form described above is particularly common in central and northern parts. The identity was checked with examination of the holotype and a few paratypes from N. Alaska, kept at MCZ. Although the types are in poor condition, details of Ant.4, maxilla and chaetotaxy of Abd.4–5 are as in my specimens.

Some peripheral populations differ from the descriptions above and may represent other species. Specimens from Pribilof Isls. (St. George) have no additional X-sensillae on Ant.4 and E & F are thinner than C & D. Maxilla is stronger with some minute teeth on lam.1 (Fig. 318). The colour is paler than in typical *weberi* and body granulation slightly coarser.

Two specimens collected in a stony river bed at Aborigen (Chukotka) differ in Ant.4 which has 3+4 and 4+4 additional X-sensillae (only 2 in *weberi* s.str.) and E & F thinner than C & D.

Distribution and ecology

Widespread and common in N and Central Alaska. *N. slope* (Meade River, Barrow, Umiat, Toolik Lake, Franklin Bluffs, Sagwon Upland, Canning River Delta), *Brooks Range* (Anaktuvuk, mts. W of Atigun Camp, "Last Spruce" S of Chandalar, Sukakpak Mt. S of Dietrich Camp), *Central* (Fairbanks – many records, Twelve Mile Mt., Mastodon Dome, Eagle Creek, Gobbler Knob S of Prospect Camp), *Alaska Range* (many sites along Denali Hwy., Summit Lake at Paxson, Flood Creek N of Paxson, Watana Mt. in Talkeetna Mts.), *Bering Area* (Pribilof Isls). In arctic and alpine tundra the species occurs in both wet and dry meadows, bogs, litter in willow thickets, etc. In Central Alaska common in litter in both coniferous an hardwood taiga. – *Total distribution:* Nearctic – (?) E. Palaearctic (Chukotka: Aborigen, see above).

4. **Anurida interior** n.sp.

Figs. 320–323.

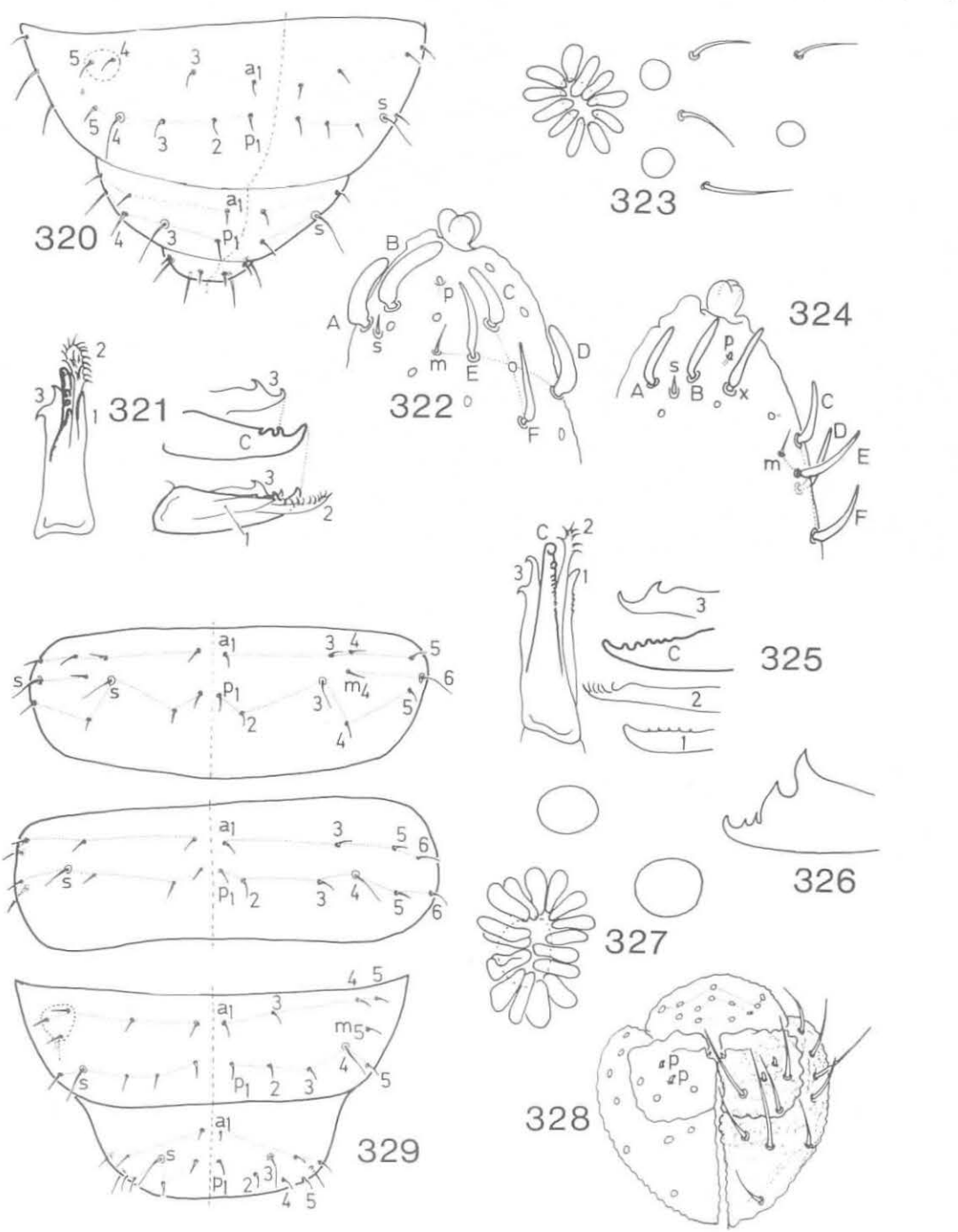
Type locality: Alaska. Golddust Creek, tributary to Eagle Creek near Mastodon Dome NE of Fairbanks (Steese Hwy.).
Type material: Holotype: One specimen (alc.) from "Alaska. Golddust Creek at Mastodon Dome. 26.VII.1980. Willow litter. A.Fjellberg leg.", at USNM. – *Paratypes*: 14 (7 alc., 7 slide) as above, at USNM. 6 (alc.) from "Alaska, Bonanza Creek Exp. Forest, Fairbanks. 10.VIII.1980. Moss in paper birch forest, N-slope. A.Fjellberg leg", at USNM. 7 (alc.) as above, except "Litter in damp alder groove", at USNM. 1 (slide) as above, except "Thick leaf litter in paper birch forest", at MCZ. 25 (alc.) as above, except "8.VIII.1980. Litter/humus under thick moss in white spruce forest", at USNM. 1 (slide) from "Alaska. Fairbanks. Washington Creek Forest Site. 17.VIII.1980. Litter in mixed black spruce, birch, alder forest along stream. A.Fjellberg leg", at AF. 3 (slide) from "Alaska. Mastodon Dome. 26.VII.1980. Alpine snow-bed meadow. A.Fjellberg leg.", at BM. 14 (11 alc., 3 slide) as above, except "Litter in alder thickets along sub-alpine stream", at USNM. 5 (alc.) as above, except "Eagle Creek. Stereocaulon on gravel in stream-bed", at USNM. 1 (slide) as above, except "27.VII.1980. Moss and litter in willows along stream", at MCZ. 8 (slide) as above, except "Thick Betula litter in thickets in valley side", at MCZ. 2 (slide) as above, except "Litter & Moss, subalpine spruce", at BM. 3 (alc.) as above, at USNM.
Derivation of name: The name reflects the distribution: Only found in Central Alaska.

Description

Colour white or with traces of bluish pigment. Eye spots darker.

Size 1.0 mm.

Head. Ant.4 with 3-lobed apical bulb and 6 blunt sensillae. A & B slightly larger than C & D, E & F much thinner than the others (Fig. 322). Head with 3+3(2) ocelli which are small, about as large as skin granules, hard to detect. PAO with 10–14 lobes (Fig. 323). Mandible with 3+2 teeth. Maxillary capitulum with strong apical tooth followed by 2–3 smaller teeth. Lam.1 simple, lam.2 with many apical serrations, lam.3 with 2 strong hooks (Fig. 321). Labium and labrum as in *papillosa*, Fig. 328.



Figs. 320–329. — 320–323. *Anurida interior* n.sp. — 320. Chaetotaxy of Abd.4–6. — 321. Maxilla. C: Capitulum. — 322. Sensillae of left Ant.4. — 323. Left PAO and ocelli. — 324–329. *Anurida papillosa*. — 324. Sensillae of left Ant.4. — 325. Maxilla. — 326. Mandible. — 327. Left PAO and anterior ocelli. — 328. Labium. — 329. Chaetotaxy of Th.2, Abd.1 & Abd.4–5.

Body granulation rather coarse, hairs short and fine. Characteristics of chaetotaxy: Th.1 with 3+3 setae. Th.2–3 as in Fig.329, though a_4 usually absent. Abd.1–3 as Fig. 329. Abd.4–6 as Fig. 320. Only 2 setae in front of p_4–p_5. Abd.5 with p_2 absent, sensilla p_3 nearly on line with p_1–p_4. Subcoxae with 2–2(3)–2(3) setae. Ventral tube with 4+4 setae. Furca reduced to 2 small warts with about 4+4 setulae. Tenacular field with 2 setae. Claws with distinct tooth at middle of inner edge. Tenent hairs acuminate.

A paler, rather small, stout and somewhat flattened species.

Discussion

The species is very similar to *weberi*, but the pale colour readily identifies it when the two species occur in the same sample, which often happens. Also the arrangement of Ant.4 sensillae is different and eye number is lower.

Distribution and ecology

Only found in Central Alaska (Fairbanks, Mastodon Dome, Eagle Creek, Eagle Summit). In forest litter, ascending to low-alpine meadows. – *Total distribution*: Nearctic.

5. **Anurida papillosa** (Axelson)

Figs. 324–329.

Micranurida papillosa Axelson, 1903:103.

Type locality: USSR. Karelia Keretina, Knjäsha.
Type material: Lectotype: One specimen (alc.) labelled "Kar. Keret. Knjäsha. 4.IX.01. W.M.A., Micranurida papillosa Axels.", at Zoological Museum, Helsinki. – *Paralectotypes:* 5 (3 slide, 2 alc.) from the lectotype sample, deposited as above.

Description

Colour pale bluish-gray, ventral side nearly white.

Size 1.7 mm.

Head. Ant.4 with 3-lobed apical bulb and 6 subequal sensillae A–E. In addition there is usually 1, rarely 2 or none, extra sensillae X (Fig. 324). Ocelli 4+4. PAO roughly circular or slightly elongate, with 14–20 lobes (Fig. 327). Mandible with 3+2 teeth (Fig. 326). Maxillary capitulum with strong apical tooth and 5–7 smaller teeth along cutting edge. Lam.1 with a few minute teeth. Lam.2 with some apical serrations, lam.3 with 2 strong hooks (Fig. 325). Labium with 8+3 setae, apical part with 2 small sensorial papillae (Fig. 328). Labrum with 5–5–2 setae.

Body. Integument with rather coarse, high, conical granules. Body hairs smooth, short. Characeristics of chaetotaxy (Fig.329): Th.1 with 4+4 setae. Th.2–3 with sensilla p_3 in front of p_4, seta a_4 sometimes absent. Abd.4 with 3 setae in front of p_4–p_5 (a_4, a_5, m_5, Fig. 329). Abd.4 with 3+3 p-setae between sensillae p_4. Abd.5 with p_2 present, sensilla p_3 moved forward in front of p_2–p_4. Sometimes sensilla p_3 is set slightly inside p_2, which may then be counted as p_4 (p_2 absent). Subcoxae with 5–5(6, 7)–6(5, 7) setae. Ventral tube with 6+6 setae. Furca represented by 2 groups of 3–4 setulae. Claws with a strong tooth near middle of inner edge. Tenent hairs acuminate.

Discussion

The species resembles *weberi*, but in mixed samples *papillosa* will be spotted by its paler colour and slightly more elongate body shape. Chaetotaxy is characeristic, notably the increased number of hairs on Th.1 and subcoxae and the arrangement of setae on Abd.5.

The above description is made from Alaskan specimens. To check the identity of the species, the original type material was examined. It consists of 6 specimens of which only 1 is intact (lectotype). The other 5 are without heads. Slides were made from 3 of the decapitate specimens and a single intact specimens from "Tarkanova, 11.VII.03. B.Poppius", identified by Axelson. A single maxilla was examined in detail, showing lam.1 without teeth (minute teeth may have been obscured), otherwise as in the Alaskan form. Ant.4 has only 2 blunt sensillae in the lateral group (X absent), in Alaskan specimens X is usually present. Subcoxae had 4–4(5)–4 setae. dorsal chaetotaxy as in Alaskan specimens, though irregularly placed setae were frequent (often one additional hair near p_2 on Th.2–3 and one near p_1 on Abd.5). Some specimens had p_3 sensilla on Abd.1–3 placed more forward than in typical Alaskan specimens. Abd.4 had only 2 setae in front of p_4–p_5, though 3 on one side in one specimen. Macrochaetae of Abd.5–6 appeared longer than in Alaskan specimens. On Abd.5 the p_2 seta was closer to the median line, nearly on line with

a_1–p_1. Ventral tube with 5+5 setae (one specimen).

Although the observed deviations go some way to fill the gap between Alaskan *papillosa* and *weberi* (Abd.4, subcoxae, ventral tube), the two species are still clearly different in Abd.5 (presence/absent of p_2). The Alaskan and European populations of *papillosa* may represent two different species, but taxonomic separation at present seems quite arbitrary.

Distribution and ecology

Many records from *Central Alaska* (Bonanza Creek Exp. Forest, Eagle Creek, Mastodon Dome, Twelve Mile Mt.). In forest litter (both conifers and hardwood) and alpine meadows. – *Total distribution:* Holarctic ? (see above).

6. **Anurida papillosoides** (Hammer)

Figs. 330–335.

Micranurida papillosoides Hammer, 1953:28.

Description

Colour bluish-gray, often rather pale.

Size 1.7 mm.

Head. Ant.4 with weakly 3-lobed apical bulb. All 6 blunt sensillae (A–F) present, E & F much thinner than the others (Fig. 331). Ocelli 4+4. PAO roughly circular, with 11–14 lobes (Fig. 334). Labium with 8+3 setae, apical part with 2 long, curved sensorial papillae (Fig. 335). Mandibles with 3(2) apical and 3(2) basal teeth. Maxillary capitulum with strong apical tooth followed by 2 smaller teeth. The subapical tooth is set slightly ventral to main axis of capitulum (Fig. 332). Lam.1, 2 and 3 all with long, hook-like filaments.

Body granulation rather fine and uniform. Hairs smooth, short. Chaetotaxy as Fig. 330. Th.1 with 3+3 setae. Th.2–3 with sensilla p_3 in posterior postion, behind p_4. Only 1 seta (a_3) in front of p_3–p_4 (a_4–m_4 absent). Abd.1–3 usually with p_2 absent, sometimes present on one or both sides of Abd.1, rarely on Abd.2, not observed on Abd.3. Seta p_3 always absent. Abd.4 without p_2–p_3, thus only 1+1 p-setae between sensillae p_4. Abd.5 without p_2. Furca reduced to small warts with about 3+3 setulae. Ventral tube with 4+4 setae. Subcoxae with 1–2–2(3) setae. Claws with a small inner tooth. Tenent hairs acuminate.

Discussion

To check the identity of the species, Alaskan specimens were compared with the Canadian types. A slide with 7 specimens labelled "Type. Collembola. Canada 1948. Coppermine 295. Micranurida papillosoides n.sp. M. Hammer" (Biosystematics Research Institute, Ottawa) was examined. The slide shows few details, but maxilla was seen in a few specimens, showing 2 apical teeth on capitulum and a long ciliate Lam.2. The other 2 lamellae could not be individually seen, but both appeared ciliate as in Alaskan specimens. Mandible have 3 equally large apical teeth and at least 2 basal teeth. Chaetotaxy was seen partly in one specimen. Th.2, Abd.1 and Abd.5 are as in Alaskan specimens. There is little doubt that the Alaskan form is the true *papillosoides*. The species is well marked and identified by maxilla (ciliate Lam.1 & 3) and chaetotaxy (p_3 in backward position on Th.2–3).

Distribution and ecology

The species is common on the *North Slope* (Meade River, Barrow, Lonely at Smith River, Umiat, Franklin Bluffs) with a few records from the *Bering Area* (Pribilof Isls., Chevak) and *Alaska Range* (Watana Mt. in Talkeetna Mts., Kenai River midway Homer-Anchorage). No records from the central taiga region. Most records are from damp tundra sites (polygon troughs, bogs, shores of streams and pools, wet meadows, etc.) – *Total distribution:* Nearctic.

7. **Anurida polaris** (Hammer)

Figs. 336–340.

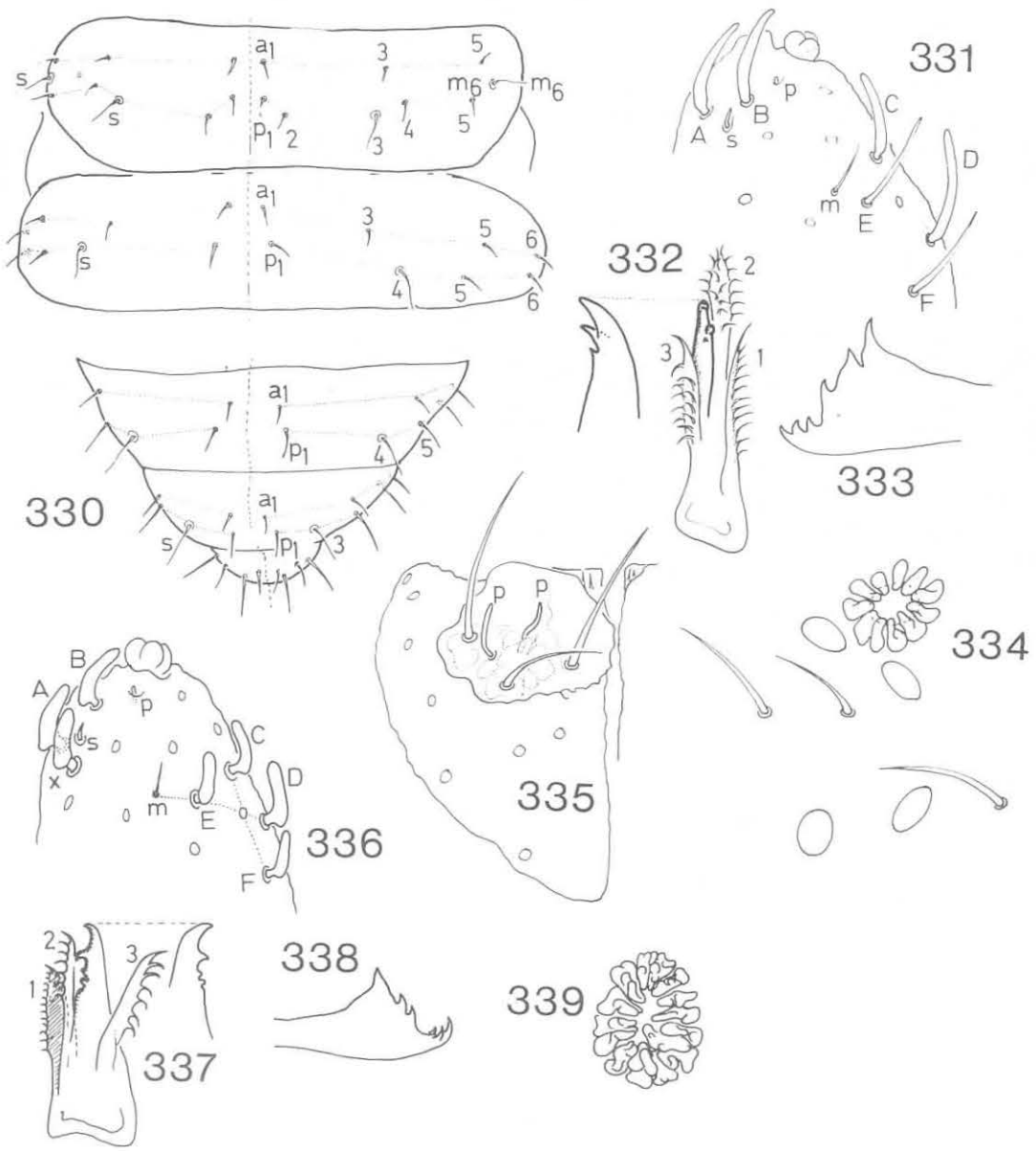
Micranurida polaris Hammer, 1954:9.
Anurida frigida Fjellberg, 1973:285, syn.nov.

Description

Colour white.

Size 1.5 mm.

Head. Ant.4 with 7 more or less hammer-shaped sensillae (A–F, X, Fig. 336). Ocelli absent. PAO with 10–15 lobes varying from nearly smooth and regular to strongly papillate/granulate (Fig.



Figs. 330–339. — 330–335. *Anurida papillosoides*. — 330. Chaetotaxy of Th.3–Abd.1 & Abd.4–6. — 331. Sensillae of left Ant.4. — 332. Maxilla. — 333. Mandible. — 334. Right PAO and ocelli. — 335. Labium. — 336–339. *Anurida polaris*. — 336. Sensillae of left Ant.4. — 337. Maxilla. — 338. Mandible. — 339. Left PAO.

339). Apical bulb of Ant.4 more or less 3-lobed, sometimes nearly simple, bulbous. Apical part of labium with 3–4 setae and 2 minute sensorial papillae, often hard to detect. Mandible with 3+3 teeth, the 3 apical ones placed slightly at side of each other. Maxillary capitulum with strong apical and subapical teeth, followed by 2–3 smaller teeth. lam.1–2 finely sagittate, Lam.3 with slightly longer and coarse serrations (Fig. 337).

Body granulation fine and uniform. Chaetotaxy

as Fig. 340. Degree of differentiation of the body hairs variable. Some individuals have all hairs thin and little differentiated, others have thicker, more strongly developed macrochaetae, notably p_1 and p_3 on Abd.4–5. Characteristics of chaetotaxy: Head with 4+4 posteromedian setae. Th.1 with 2+2 setae. Th.2–3 with p_2 behind p_1, m_4 present. Abd.1–3 with 2 setae (a_3,a_4) in front of p_3–p_4. Abd.4 with 3+3 p-setae between the sensillae p_4. Furca absent, a few setulae present in the furcal field. Ventral tube with 4+4 setae. Subcoxae with 1–2–2 setae.

A rather slim, cylindrical species, though individuals of a more stout body shape are also seen.

Discussion

Examination of the two type specimens from N. Greenland ("Micranurida polaris Hammer, 1954. Type. Heilprin Land. Ranunculus sulphuresus, Saxifraga setigera, 13.7.1949. 1140. Johnsen leg.", Zool. Mus., Copenhagen) makes it clear that this is the same species as *Anurida frigida* Fjellberg that I described from Swedish Lapland (Fjellberg 1973). Chaetotaxy and the peculiar PAO are identical.

Very probably *Anurida remyi* Denis, 1947 is also the same species. Denis (1947) proposed that name for the arctic populations of *A. granaria* (Nicolet), which he found morphologically distinct. Still another form, *A. thalassophila* (Bagnall, 1939) complicates the matter. It is a common littoral form along N. European coasts, but not yet found in the Arctic where it seems to be replaced by *polaris*. The only sharp difference between *thalassophila* and *polaris* is presence of 4+4 setae on Th.1 in the former and 2+2 in the latter. The other characters that I used when I first separated the forms (Fjellberg 1973), are more or less variable (granulation, strength of macrochaetae, PAO, Ant.4 sensillae). If future research shows the distribution of the two forms to be largly allopatric, then they are possibly subspecies of the nominal species *thalassophila*.

Distribution and ecology

Widely distributed, very common on the Arctic coast. *N. Slope* (Canning River Delta, Prudhoe Bay, Barrow, Meade River, Icy Cape, Franklin Bluffs, Happy Valley Cut), *Brooks Range* (Anaktuvuk, mts. W of Atigun Camp), *Central* (Spinach Creek, Willow Creek and Washington Creek at Fairbanks, Mastodon Dome, Eagle Creek, Twelve Mile Mt.), *Alaska Range* (several places along Denali Hwy., Watana Mt. in Talkeetna Mts.), *Bering Area* (Chevak, Bethel).

Most records are from damp habitats in arctic/alpine tundra (bogs, polygon throughs, shores of lakes and streams, wet meadows, etc.). A few records from drier habitats. Never found in deep litter in the coniferous taiga in Central Alaska. – *Total distribution*: Holarctic (Alaska, Chukotka (Aborigen, Chaun Bay), Spitsbergen, Greenland, Norway, Sweden).

The populations in Europe are apparently parthenogenetic as no males are seen. In Alaska males are generally present.

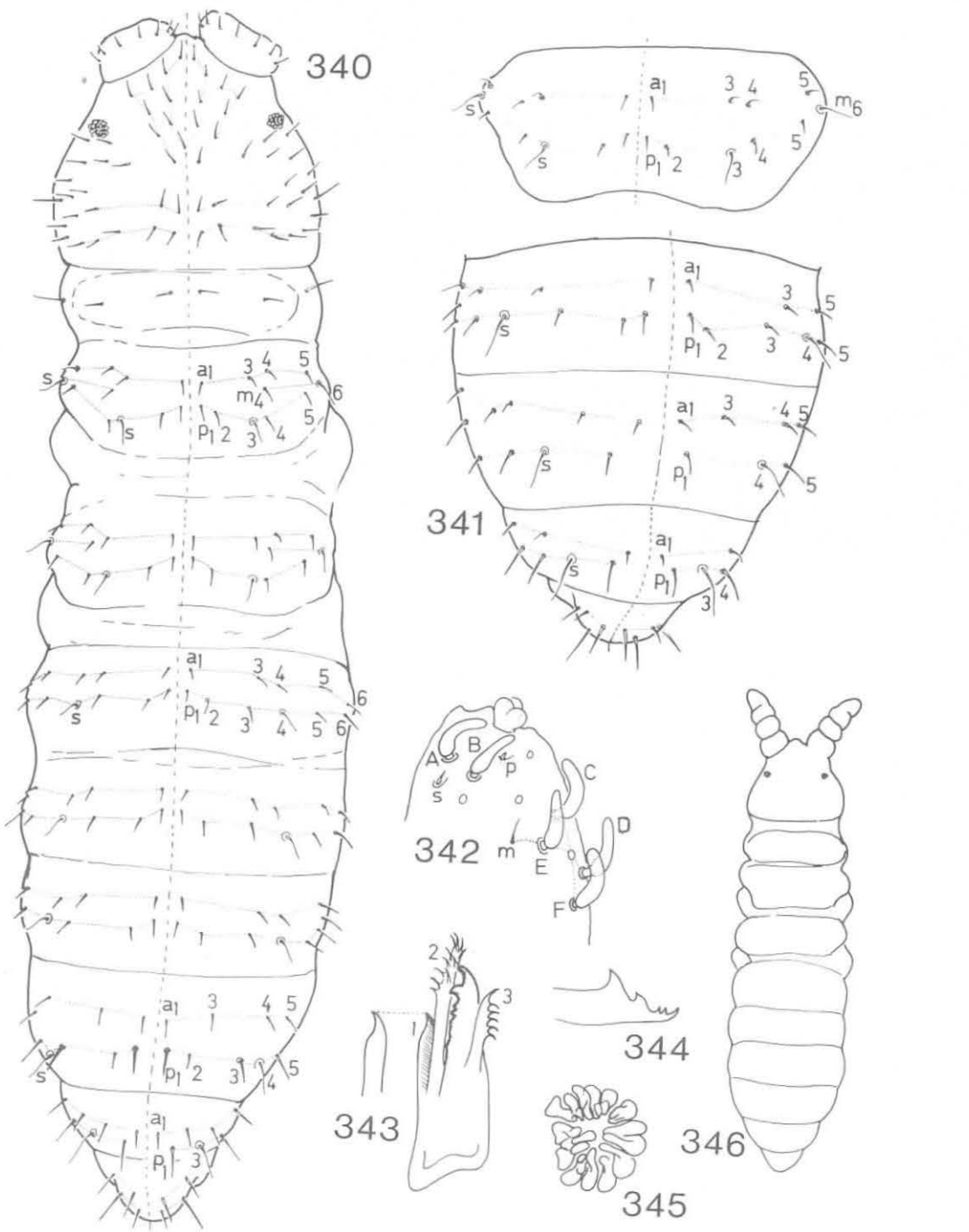
8. **Anurida subarctica** n.sp.

Figs. 341–346.

Type locality: Inner part of Golddust Creek (tributary to Eagle Creek) at Mastodon Dome, NE of Fairbanks (Steese Hwy.).
Type material: Holotype: One reproductive male (alc.) from "Alaska. Golddust Creek at Mastodon Dome. Low-alpine, rich meadow. 26.VII.1980. A.Fjellberg leg.", at USNM. – *Paratypes*: 15 (2 slide, 13 alc.) from the holotype sample, at USNM. 2 (slide) as above, except "Wet meadow", at BM. 1 (slide) from "Alaska. Eagle Creek. 1.VII.1976. Moist willow litter, 750 m alt. A.Fjellberg leg.", at MCZ. 2 (slides) as above, except "Eagle Summit. Thick grass turf in manured owl mound, 1,200 m alt.", at USNM. 2 (slides) from "Alaska. Below Gobbler Knob S of Prospect Camp. 20.VIII.1976. Alnus litter in moist birch/lichen slope. V. Behan leg.", at USNM. 1 (slide) from "Alaska. Plains S of Willow Creek, N. Fairbanks (S of Washington Creek), 17.VIII.1980. Moss & willow litter, bogs. A.Fjellberg leg.", at USNM.
Derivation of name: The name indicates the distribution of the species.

Description

Colour white.
Size 0.9 mm.
Head. Ant.4 with 3-lobed apical bulb and 6 subequal blunt sensillae (Fig. 342). No additional X-sensilla. Ocelli absent. PAO with 11–17 slightly irregular lobes (Fig. 345). Basal part of labium with 8 setae. Apical part with 2 small sensorial papillae in addition to the 3 setae. Mandible with 3+2 teeth, the apical 3 set after each other in a line. Maxillary capitulum with strong apical and subapical teeth, followed by 2–4 smaller teeth along



Figs. 340–346. — 340. *Anurida polaris*. Chaetotaxy. — 341–346. *Anurida subarctica* n.sp. — 341. Chaetotaxy of Th.2 & Abd.3–6. — 342. Sensillae of left Ant.4. — 343. Maxilla. — 344. Mandible. — 345. PAO. — 345. General body shape.

the cutting edge. Lam.1 simple, pointed, without serrations. Lam.2 with many serrations in apical part. Lam.3 with 5–8 serration (Fig. 343).

Body granulation rather coarse, uniform. Hairs short, smooth. Characteristics of chaetotaxy (Fig. 341): Posteromedian field of head with 4+4(3) setae. Th.1 with 3+3 setae. Th.2–3 with p_2 behind p_1. Only 2 setae (a_3, a_4) in front of p_3–p_4. Seta m_4 absent, rarely also 1 of the a_3–a_4 absent. Abd.1–3 sometimes with p_2 absent on one or both sides, especially on Abd.3. Only 1 seta (a_3) in front of p_3–p_4. Abd.4 with only 1+1 p-setae between the p_4 sensillae, p_2–p_3 absent. Abd.5 with p_2 absent. Ventral tube with 4+4(5) setae. Subcoxae with 1–2–3(2) setae. Furca absent, no setulae in furcal field. Claws simple, without inner tooth. Tenent hairs short, acuminate.

Discussion

The species resembles *polaris*, but is separated by chaetotaxy (absence of m_4 on Th.2–3, absence of a_4 on Abd.1–3, absence p_2–p_3 on Abd.4). Also maxillary Lam.1 differs, beeing smooth in *subarctica*, sagittate in *polaris*. Moreover, Ant.4 lacks the additional X-sensilla found in *polaris*.

Distribution and ecology

Only a few records from Central and N. Alaska. *N. Slope* (Franklin Bluffs), *Central* (Fairbanks, Gobbler Knob S of Prospect Camp, Twelve Mile Mt., Eagle Summit, Eagle Creek, Mastodon Dome).

Collected in meadows (both wet and dry), in litter of willow and alder, etc. – *Total distribution*: Nearctic – E. Palaearctic (Chukotka: Aborigen).

Anurida martynovae n.sp.

Figs. 347–351.

Type locality: Alaska. Watana Mt. in Talkeetna Mts. *Type material: Holotype:* One specimen (alc.) from "Alaska. Watana Mt. in Talkeetna Mts. 12.VIII.1980. Snow-bed meadow, 6,000 ft. S.F.MacLean leg.", at USNM. – *Paratypes:* 32 (alc.) from the holotype sample, at USNM. 4 (slide) as above, at MCZ. 35 (alc.) from "Alaska. St. George Isl., Pribilof Isls. 19.VIII.1980. Meadow behind village water tower. R.H.Day leg.", at USNM. 6(slide) as above, at BM. 5 (alc.) from "Alaska. Lonely, Smith River. 30.VII.1976. Moist polygon trough. C.Connors leg.", at USNM. 2 (slide) as above, at MCZ. 6 (4 alc., 2 slide) from "Alaska. Denali Hwy., 120 mi from Paxson. Mts. S of road. 29.VII.1980. Lush snow-bed meadow, 3,500 ft. A.Fjellberg leg.", at USNM. 4 (slides) from "Alaska. Chevak, Yukon/Kuskokwim Delta. 4.VII.1976. Mesic upland with moss and Betula nana. T.Seastadt leg.", at USNM. 3 (slide) as above at BM, 1 (slide) from "Alaska. Meade River, 25.VIII.1976. Moist grass and litter in old lemming nest at edge of dried-out pool. A.Fjellberg leg.", at USNM. 2 (slide) as above, except "Thick, rather dry tufts of Silene acaulis and Dryas on sandy river slope", at USNM. 1 (slide) as above, except "28.VIII.1976. Sandy, thick humus and litter in Salix shrubs at S end of airstrip", at USNM. 2 (slide) from "Alaska. Cape Thompson. Ogoturuk Creek Basin. 7–11.VIII.1980. Wet snow-bed meadow. D. & B.Murray leg.", at USNM. 1 (slide) from "Alaska. S of Chandalar. Last Spruce". 20.VIII.1976. Dry litter/humus in stand of white spruce. A.Fjellberg leg.", at USNM. 2 (slide) from "Alaska. High mt. 1–2 mi W of Atigun Camp. 19.VIII.1976. Middle alpine owl mound. Grass turf with rich flora. A.Fjellberg leg.", at USNM. 2 (slide) from "Alaska. Cape Krusenstern. 3.IX.1976. Grass & Salix litter. R. Greenberg leg."at USNM. 2 (slide) from "Alaska. Great Pingo 10 mi NW Franklin Bluffs. 17.VIII.1976. Thick Dryas/Kobresia/Carex cushions on top of pingo. A.Fjellberg leg.", at USNM. 2 (slide) from "Alaska. 14 mi Denali Hwy. 31.VII.1980. Lush meadow, upland tundra, 3,700 ft. A.Fjellberg leg.", at USNM.

Derivation of name: Named in honour of Dr. E. F. Martynova, Leningrad.

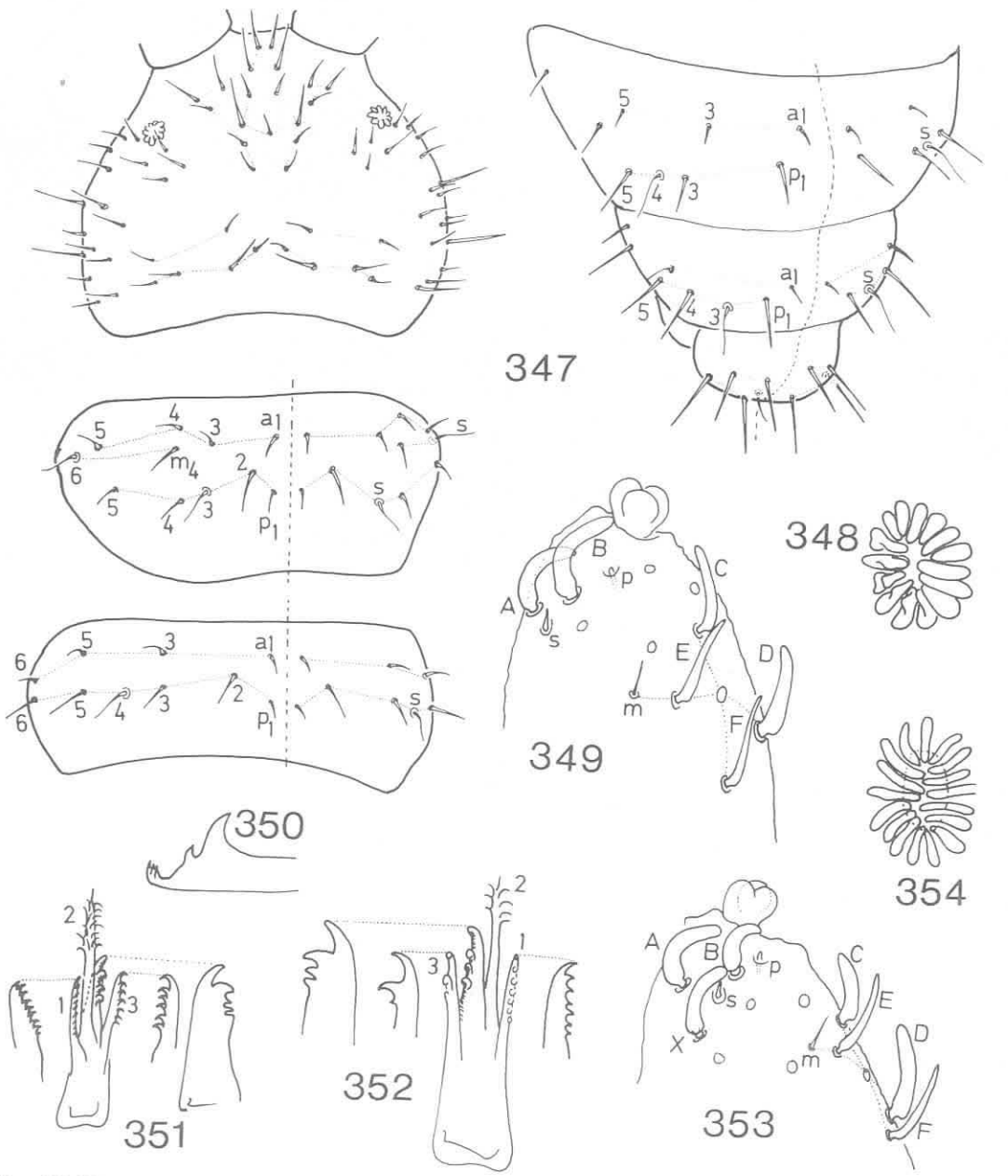
Description

Colour white or slightly creamy yellow.

Size 1.2 mm.

Head. Ant.4 with 3-lobed apical bulb and 6 blunt sensillae, E & F thinner than others. No additional X-sensilla (Fig. 349). Ocelli absent. PAO with 12–16 regular lobes in roundish/elongate arrangement (Fig. 348). Labium with 8+3 setae, apical part with 2 small sensorial papillae. Mandible with 3+2 teeth. The apical 3 in an oblique, transverse row (Fig. 350). Maxillary capitulum with strong apical and subapical teeth, followed by 2–3 smaller teeth (Fig. 351). Lam.1 thin, membraneous, with fine serrations. Lam.2 strong, passing far beyong tip of capitulum. Apical part with many curved filaments. Lam.3 with rather few (3–7) serrations.

Body. Granulation rather coarse, uniform. Body hairs well differentiated, longest macrochaetae distinctly serrate/ciliate. Characteristics of chaetotaxy (Fig. 347): Posteromedian field of head with 3+3 setae. Th.1 with 3+3 setae. Th.2–3 with p_2 in forward position, in front of p_1. Seta m_4 present. Abd.1–3 with p_2 in front of p_1. Only one seta (a_3) in front of p_3–p_4. Abd.4 with 2+2 p-setae between sensillae p_4, p_2 absent. Abd.5 without p_2.



Figs. 347–354. — 347–351. *Anurida martynovae* n.sp. — 347. Chaetotaxy of head, Th.2, Abd.1 & Abd.4–6. — 348. PAO. — 349. Sensillae of left Ant.4. — 350. Mandible. — 351. Maxilla. — 352–354. *Anurida similis* n.sp. — 352. Maxilla. — 353. Sensillae on left Ant.4. — 354. PAO.

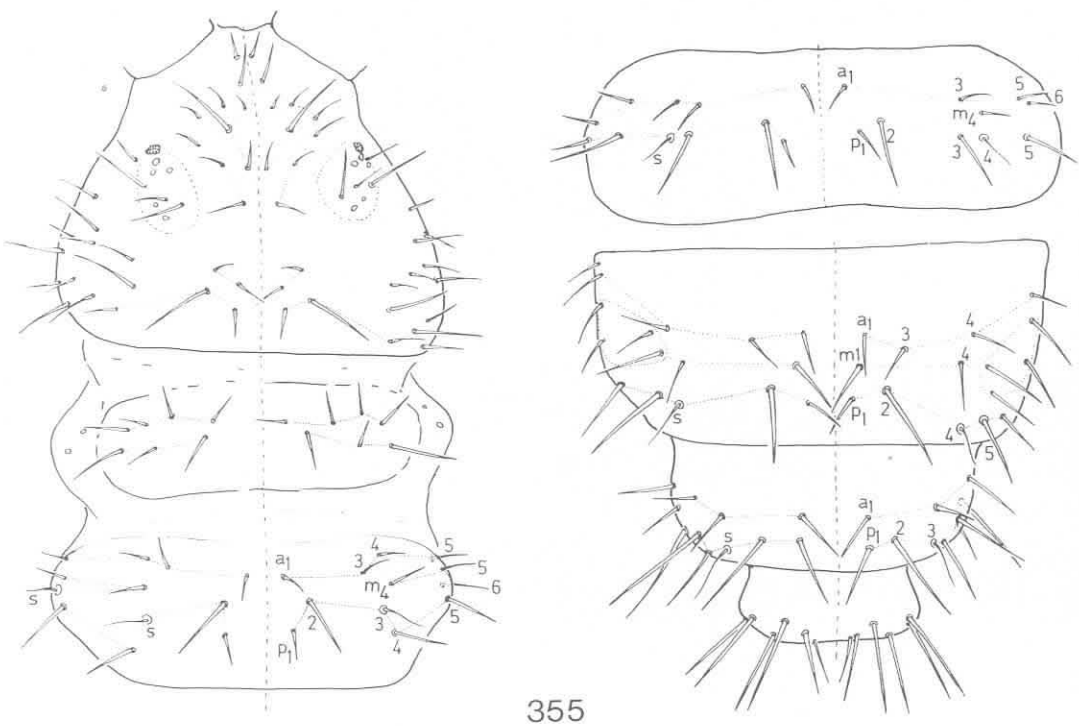


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Fig. 355. *Anurida hammerae*. Chaetotaxy of head, Th.1–2, Abd.1 & Abd.4–6.

Ventral tube with 4+4(5) setae. Furca absent, a few small setulae present in furcal field. Subcoxae with 1–2–2 setae. Claws simple, without teeth. Tenent hairs acuminate.

Discussion

Superficially the species resembles *polaris*, which is often present in the same sample. However, in mixed samples *martynovae* may be recognized by the slightly stouter body shape and the somewhat yellowish (not pure white) colour. The chaetotaxy readily separates the species, notably the forward position of p_2 on Th.2–Abd.3 in *martynovae*. Systematically the species is probably closest to *similis* n.sp. which has the same chaetotaxy. For separation, see discussion of *similis* below.

Distribution and ecology

Probably present in most of Alaska (*N. Slope, Brooks Range, Central, Alaska Range, Bering Area)*. For details, see type material above.

Collected in a wide variety of habitats in arctic and alpine tundra (some records in subarctic/subalpine forest). — *Total distribution:* Nearctic – E. Palearctic (Chukotka: Chaun Bay).

10. **Anurida similis** n.sp.

Figs. 352–354.

Type locality: Alaska. Canning River Delta.
Type material:Holotype: One specimen (alc.) from "Alaska. Canning River Delta. 23.VII.1980. Moss & Salix rotundifolia below 1 m bluff. S.F.MacLean leg.", at USNM. – *Paratypes:* 33 (alc.) from holotype sample at USNM. 7 (slide) as above, at MCZ. 6 (4 alc., 2 slide) from "Alaska. Great Pingo 10 mi NW Franklin Bluffs. 17.VIII.1976. Moss at exit of lemming burrow. V.Behan leg.", at USNM. 23 (20 alc., 3 slide) from "Alaska. Happy Valley Cut. 17.VIII.1976. Thick leaf litter in dense stand of Alnus crispa. A.Fjellberg leg.", at USNM. 4 (slide) as above, at BM. 29 (26 alc., 3 slide) from "Alaska. Meade River. 26.VIII.1976. Dry

meadows on sandy hill at Pingo Lake. A.Fjellberg leg.", at USNM. 1 (slide) from "Alaska. Kotzebue. Primo July 1980. Tundra. Moss, lichens, Ledum, Carex. J.Blanchard leg.", at USNM. 4 (slide) from "Alaska. Colville River Delta. Late July 1976. Dry polygon ridge. L.Underwood leg.", at USNM.
Derivation of name: The name reflects the morphological similarity to other species in this group.

Description

Colour white.
Size 1.0 mm.
Head. Ant.4 with 3-lobed apical bulb and the 6 blunt sensillae A–F, of which E & F are much thinner than other. In addition 1 (rarely 2) extra sensillae (X) are present in the lateral group behind A–B (Fig. 353). Ocelli absent. PAO with 15–22 regulare strongly elongate lobes in oval arrangement (Fig. 354). Labrum and labium normal. Apical part of labium with 2 small sensorial papillae. Mandible with 3+2 teeth. The apical 3 in an oblique row. Maxillary capitulum with strong apical and subapical teeth, followed by 2 smaller teeth. Lam.1 thin, with fine serrations. Lam.2 passing tip of capitulum, with many apical serrations. Lam.3 strong, with 2 large, hook-like teeth followed by 1–2 minute teeth (Fig. 352).
Body. Granulation fine, uniform. Body hairs fine, rather short, smooth. Only the longest macrochaetae at tip of abdomen with slight ciliation. Dorsal chaetotaxy as in *martynovae*, Fig. 347, though specimens with irregularly placed setae are very frequent. Specimens with a small p_2 seta present on one or both sides of Abd.4 are common. Subcoxae with 1–2–3(2) setae. Ventral tube with 4+4 or 5+5 setae. Furca absent, a few setulae present in furcal field. Claws simple, without teeth. Tenent hairs acuminate.

Discussion

The forward position of p_2 on Th.2–3 makes the species very similar to *martynovae*. This arrangement of setae is otherwise only found in the *hammerae* group, which differs from *similis/martynovae* by having also the sensillae p_3 moved forward, in front of p_4 (Fig. 355). *A. similis* differs from *martynovae* by the 1–2 additional sensillae (X) on Ant.4, a more elongate PAO with very narrow, transversly set lobes and the characteristically hooked lam.3 of maxilla.

Distribution and ecology

Only found in arctic tundra in N. Alaska. *N. Slope* (Canning River Delta, Colville River Delta, Barrow, Meade River, Happy Valley Cut, Franklin Bluffs), *Bering Area* (Kotzebue). The few records indicate a preference for rather dry habitats (see type material above). – *Total distribution:* Nearctic – E. Palaearctic (Chukotka: Aborigen. In deep leaf litter of *Alnus* on river slope).

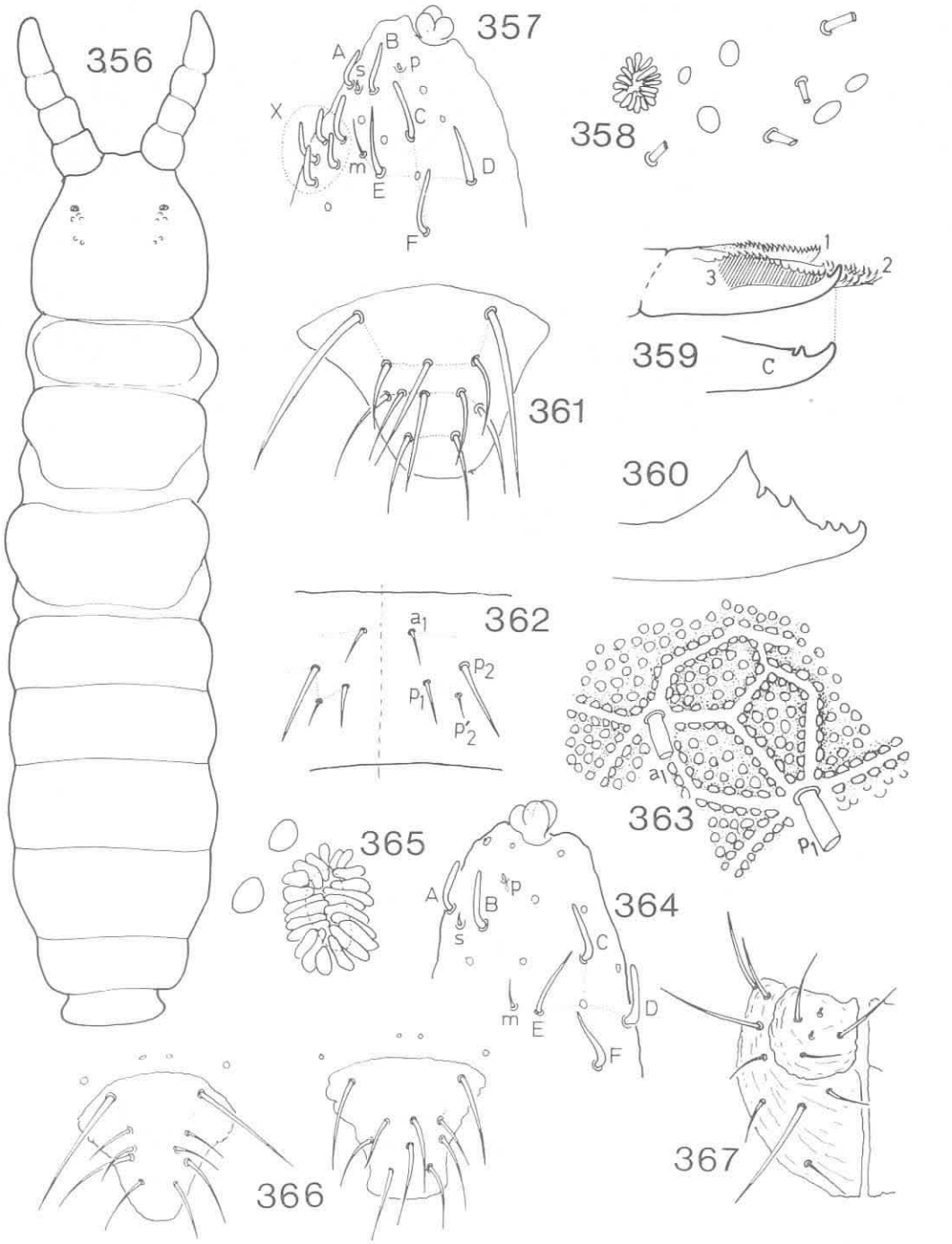
A. hammerae group

Description

This species group comprises a number of forms which are all morphologically similar, yet highly diverse.
Colour. A unique feature is the lack of pigment in some species in spite of presence of ocelli (*hammerae, narli)*.
Head. The antennae are strong, slender and longer than usual in the genus. Number of ocelli variable (8, 5, 3, 0).
Body shape is generally slender with a tendency to having Abd.6 constricted at base (Fig. 356). Chaetotaxy differs from other *Anurida* in having both p_2 and p_3 on Th.2–3 moved forward, in front of p_1 and p_4. Some other species may have p_2 *or* p_3 moved forward, but never both at the same time. Within the group there is a marked tendency to reduce the number of axial hairs (a_1–p_1–p_2) on thorax and abdomen. *A. hammerae* has a full set with p_1 present on all Th.2–Abd.4 segments. *A.* sp.1 (Mt. Rainier, Washington) has lost p_1 on Abd.4. *A. beringi* has lost p_1 on Abd.1–4. *A.* sp.2 (Aborigen, Chukotka) has p_1 generally absent also on Th.2–3, but occasionally present in some individuals. The final stage is reached in *reducta* and *narli* which always have p_1 absent on all segments of Th.2–Abd.4.

Discussion

The *hammerae* group appears more related to the Neanurinae than the other *Anurida*. The axial chaetotaxy is principally like that of *Paranura* (in *beringi* identical), now generally recognized as belonging to Neanurinae (Deharveng 1981). The square shape of Abd.6 (*hammerae*, sp.2) and the



Figs. 356–367. — 356–362. *Anurida hammerae*. — 356. General body shape. — 357. Sensillae of left Ant.4. — 358. Left PAO and ocelli. — 359. Maxilla. — 360. Mandible. — 361. Labrum. — 362. Median part of Abd.3 with p'_2 present. — 363–367. *Anurida beringi* n.sp. — 363. Reticulate pattern on Abd.5. — 364. Sensillae of left Ant.4. — 365. PAO. — 366. Labrum, 2 different specimens. — 367. Labium.

reticulate integument of *beringi* point the same way.

Distribution

Distribution of the group falls within the boreal taiga and arctic/alpine tundra. Four species are found in Alaska, of which 3 are amphiberingian. Two other species (sp.1 and sp.2 above) are described in a separate paper (Fjellberg 1984c).

11. **Anurida hammerae** Christiansen

Figs. 355–362.

Anurida hammeri Christiansen, 1951:135.

Description

Colour white, live specimens lemon yellow.
Size 3.0 mm.

Head. Ant.4 with a protruding, deeply 3-lobed apical bulb. Number of blunt sensillae variable. In addition to the 6 standard sensillae (A–F), up to 9 additional sensillae (X) may be present laterally behind A–B (Fig. 357). Ocelli 5+5(4). Individual eye size and position rather variable. Somtimes 2 eyes are more or less fused. Dark eye pigment absent. PAO with 13–20 lobes in roundish or slightly elongate arrangement (Fig. 358). Mandibles usually with 3+3 teeth (Fig. 360). Maxillary capitulum with 3 teeth, the apical one strongest. Lam.1 & 3 sagittate. Lam.2 with 2–3 irregular rows of hooked filaments, projecting beyond tip of capitulum (Fig. 359). Labrum with 5–5–2 setae (Fig. 361). Basal part of labium with 8 setae. Apical part with 3 setae and 2 finger-like sensorial papillae.

Body. Granulation fine and uniform. Body hairs rather long, erect. Characteristics of chaetotaxy (Fig. 355): Th.1 moderately plurichaetotic, with many setae set in more than 1 row. Th.2–3 with p_2–p_3 moved forward, m_5 present. Abd.1–3 quite variable, but generally as Fig. 355. Macrochaeta p_2 moved in front of p_1. Abd.4 slightly plurichaetotic, especially in the m-group in front of p_4–p_5. A large m_1 seta is usually present between the smaller a_1–p_1. Rarely a p_3 seta may be present inside and obliquely in front of sensilla p_4. A supernumerary seta may be found behind and between p_4–p_5. Abd.5 with both p_1–p_2 present. Abd.6 square, usually distinctly constricted at base. Ventral tube with 7–9 setae on each side. Furca absent. Tibiotarsal tenent hairs acuminate, short. Claws with a strong inner tooth in basal part.

Discussion

The large size and striking yellow colour makes this species very conspicuous in the field. Systematically the species takes an isolated position in *Anurida*. The presence of m_5 on Th.2–3, giving 4 setae in the lateral group (a_5, m_5, m_6, p_5), is seen in no other *Anurida* examined so far, but is found in *Paranura* which is now placed among Neanurinae (Deharveng 1981).

Distribution and ecology

Probably widespread in northern and central Alaska. *N. Slope* (Barrow, Happy Valley Cut, Toolik Lake), *Brooks Range* ("Last Spruce" S of Chandalar), *Central* (Kanuti River S of Old Man Camp, Fairbanks area – many localities, Mastodon Dome, Eagle Creek), *Alaska Range* (Denali Hwy., several places), *Beringe Area* (Kotzebue, Nunivak Island).

Common in thick, damp deposites of alder and willow litter in the arctic tundra. In central Alaska in litter of both hardwood and conifers. High numbers were observed in willow litter in tall shrubs along Tanana River at Fairbanks (Chena Pump Station). – *Total distribution:* Nearctic – E. Palaearctic (Chukotka: Aborigen, Chaun Bay).

Note

Christiansen (1951) originally spelt the name *hammeri*. Although not explicitly stated by the author, the species was named after Dr. Marie Hammer and the correct suffix should be feminine, thus *hammerae*.

12. **Anurida beringi** n.sp.

Figs. 363–371.

Type locality: Alaska. Brooks Range. "Last Spruce" S of Chandalar, 180 mi N of Yukon Bridge.
Type material: Holotype: One specimen (alc.) from "Alaska. Brooks Range. "Last Spruce" S of Chandalar. 20.VIII.1976. dry litter of white spruce. A.Fjellberg leg.", at USNM. – *Paratypes*: 6 (alc.) from holotype sample, at USNM. 1 (slide) as above, at MCZ. 5 (3 alc., 2 slide) from "Alaska, Yukon/Kuskokwim Delta. Chevak. 9.VII.1976. Dry upland with lichens, Ledum, Empetrum. T.Seastadt leg.", at USNM. 1 (alc.) from

"Alaska. N. Slope. Happy Valley Cut. 17.VIII.1976. Litter of Alnus crispa. A.Fjellberg leg.", at USNM. 1 (alc.) from "Alaska. Prudhoe Bay. Pt. McIntyre. 16.VIII.1976. Litter, lemming burrows. V.Behan leg.", at USNM. 1 (slide) as above, at BM. 1 (slide) from "Alaska. Meade River. 25.VIII.1976. Litter in Salix shrubs on sandy river slope. A.Fjellberg leg.", at USNM. 1 (slide) from "Alaska. Brooks Range. High mt. W of Atigun Camp. 20.VIII.1976. Lichens, alpine tundra. V.Behan leg.", at USNM. 1 (slide) from "Alaska. Toolik Lake. 18.VIII.1976. Wet meadow. A.Fjellberg leg.", at BM. 6 (alc.) from "Alaska. Fairbanks. University Forest Area. 15.VIII.1980. Leaf litter in tall Populus balsamifera stand. A.Fjellberg leg.", at USNM. 2 (slide) as above, at MCZ.

Derivation of name: Named after Vitus Bering (1680 – 1741), Danish/Russian sea captain who served tsar Peter the Great and explored the coasts of Siberia, Alaska and the Aleutians.

Description

Colour. Pale, spotted blue. Sometimes nearly white with only eye spots dark. Small juveniles with ocelli individually pigmented.

Size 2.2 mm.

Head. Ant.1–2 with long, erect hairs, notably longer than the fine hairs on the 2 terminal segments. Ant.4 with 3-lobed apical bulb and 6 blunt sensillae, of which E is much thinner than others (Fig. 364). Ocelli 5+5. PAO elongate, with 19–25 densely packed lobes (Fig. 365). Chaetotaxy of labrum variable (Fig. 366). Labium with 8+3 setae and 2 minute sensorial papillae (Fig. 367). Maxillary capitulum with strong apical and subapical teeth, followed by several (7–8) smaller teeth along the cutting edge. Lam.1 & 3 sagittate. Lam.2 with many long, apical filaments (Fig. 369). Mandible with 3 small apical teeth in an oblique row and 2 large basal teeth (Fig. 371).

Body granulation fine, uniform, granules often arranged in rows radiating from setal bases, making a reticulate pattern like that found in Neanurinae (Fig. 363). The reiculation is variable, but may be found all over the dorsal side, though strongest on Abd.5–6 and on head/antennae. Body hairs rather coarse, erect, more or less ciliate/serrate. Chaetotaxy as Fig. 368. Th.1 with 3+3 setae. Th.2–3 with both p_2–p_3 moved forward, in front of p_1 and p_4. Lateral group without m_5. Three setae (a_3, a_4, m_4) present in the group in front of p_3–p_4. Abd.1–4 without p_1. Abd.4 with 2+2 p-setae between the sensillae p_4. Abd.5 without p_2. Furca reduced to 2 small tubercles with 3+3 setulae. Ventral tube with 6–8 setae on each side. Claws with distinct tooth in middle of inner edge. Tenent hairs short, acuminate. Some of the inner tibiotarsal hairs prolonged (Fig. 370).

A broad, thick species. Abd.6 sometimes weakly constricted at base, of square shape.

Discussion

This is probably the species called *tullbergi* Schött by earlier autors (Hammer 1953, Christiansen & Bellinger 1980). I have compared Alaskan specimens with Norwegian *tullbergi* (type locality is Uppland in Sweden), and the chaetotaxy is very different (Fig. 373). On Th.2–3 p_2 is in normal position, behind p_1. Abd.1–3 with both p_1–p_2 present, p_3 and a_3 absent. Abd.4–5 are similar in the 2 species, but *tullbergi* has some of the lateral m-setae (m_5–m_6) present on Abd.4. Moreover, Abd.6 in *tullbergi* is very prominent, conical, unlike the square shape seen in *beringi*. The maxillae are similar, but mandibles differ as *tullbergi* has 4+3 teeth (Fig. 372), *beringi* 3+2.

In damp, thick moss in alpine snow-fields at Aborigen (Chukotka) a form nearly identical to *beringi* was found. Live colour was bright yellow (fading to white in alcohol), blue pigment only present in the eye spots (5+5 ocelli). The peculiar dorsal reticulation, chaetotaxy and body shape as in typical *beringi*. The claws are generally broader with a stronger inner tooth set closer to base of inner edge (Fig. 370). Until more is known about the geographical distribution of the various forms, the Aborigen and Alaskan forms are considered conspecific.

Distribution and ecology

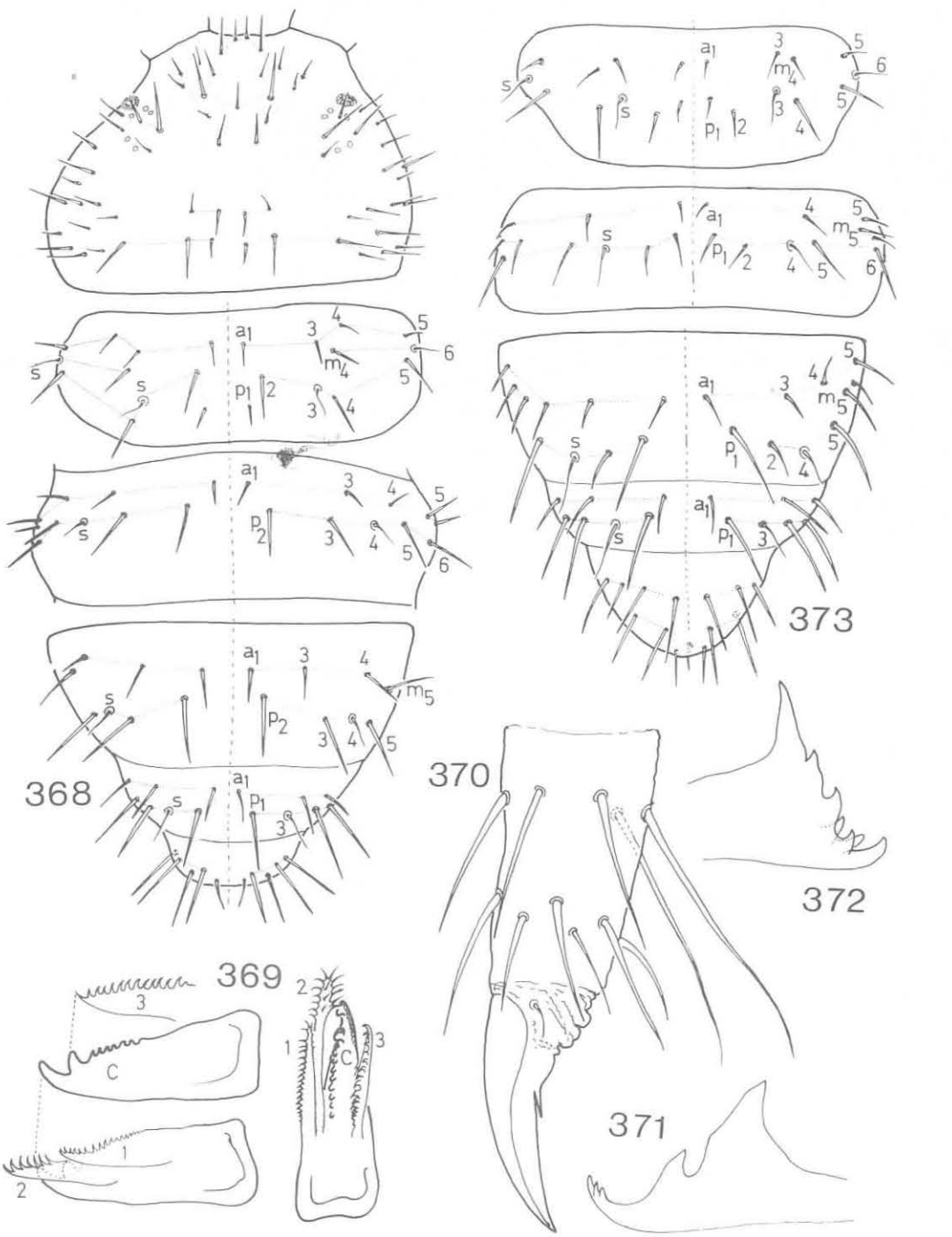
Scattered records in northern and central Alaska. *N. Slope* (Meade River, Prudhoe Bay, Happy Valley Cut, Toolik Lake), *Brooks Range* (mts. W of Atigun Camp, "Last Spruce" S of Chandalar), *Central* (Fairbanks), *Bering Area* (Chevak).

Most records from moderately dry sites (see type material above) – *Total distribution*: Nearctic – E. Palaearctic (Chukotka: Chaun Bay, ? Aborigen)

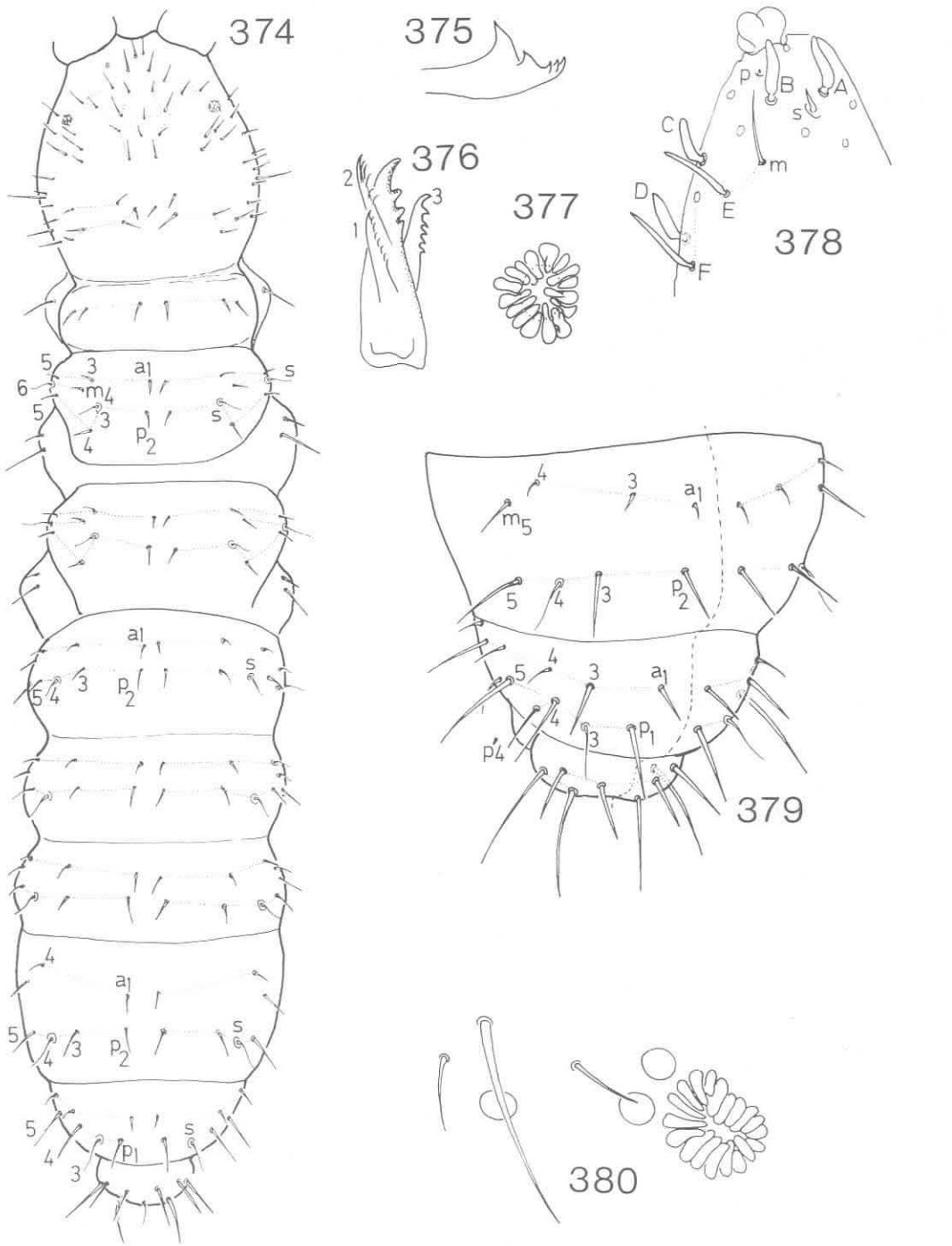
13. **Anurida reducta** n.sp.

Figs. 374–378.

Type locality: Alaska. Fairbanks. Forest behind Institute of Arctic Biology, West Ridge.



Figs. 368–373. — 368–371. *Anurida beringi* n.sp. — 368. Chaetotaxy of head, Th.2, Abd.1 & Abd.4–6. — 369. Maxilla. — 370. T.3 of specimen from Aboringen. — 371. Mandible. — 372–373. *Anurida tullbergi*, Norwegian specimen. — 372. Mandible. — 373. Chaetotaxy of Th.2, Abd.1 & Abd.4–6.



Figs. 374–380. — 374–378. *Anurida reducta* n.sp. — 374. Dorsal chaetotaxy. — 375. Mandible. — 376. Maxilla. — 377. PAO. — 378. Sensillae of left Ant.4. — 379–380. *Anurida narli* n.sp. — 379. Chaetotaxy of Abd.4–6. — 380. Right PAO and ocelli.

Type material: Holotype: Male (alc.) from "Alaska. Fairbanks. University Forest Area. 22.VII.1980. Deep layers in squirrel cone heap. A.Fjellberg leg.", at USNM. – *Paratypes:* 17 (alc.) from holotype sample, at USNM. 4 (slide) as above, at USNM. 5 (slide) as above, at BM. 2 (slide) as above, except "Damp, partly rotten moss/grass in nest of squirrel in cone heap," at USNM. 2 (slide) as above, at AF. 1 (slide) from "Alaska. Fairbanks. Bonanza Creek Exp. Forest. 8.VIII.1980. Humus/litter under thick moss in white spruce forest. A.Fjellberg leg.", at USNM.
Derivation of name: The name indicates the advanced stage of reduction in chaetotaxy and absence of eyes.

Description

Colour white.
Size 1.0 mm.

Head. Ant.4 with 3-lobed apical bulb and 6 blunt sensillae, of which E & F are hair-like, much thinner than others (Fig. 378). Ocelli absent. PAO with 13–18 lobes in roundish or slightly oval arrangement (Fig. 377). Labrum and labium normal. Apical part of labium with 3 setae and 2 small, peg-like sensorial papillae. Mandibles with 3+2 teeth, the apical 3 in an oblique row (Fig. 375). Maxilla with strong apical tooth followed by 2–3 smaller teeth. Lam.1 weak, membraneous, with 5–6 fine serrations. Lam.2 with a few long apical filaments, reaching slightly beyond tip of capitulum. Lam.3 strong, with 5–6 coarse serrations (Fig. 376).

Body granulation fine, uniform. Body hairs short and thin, slightly longer and more differentiated in micro/macrochaetae towards tip of abdomen. Longest hairs distinctly ciliate. Chaetotaxy as Fig. 374. Th.1 with 4+4(3) setae. Th.2–3 with p_1 absent. Sensilla p_3 in forward position, in front of p_4. Only 2 setae (a_3, m_4) present in front of p_3–p_4. Abd.1–4 without p_1. Abd.4–5 without a_3. Abd.6 square, sometimes weakly constricted at base. Subcoxae with 1–2–2 setae. Ventral tube with 4+4 setae. Furca absent, furcal field sometimes with a few setulae (3+3). Claws with weak inner tooth. Tenent hairs acuminate.

A slender, somewhat *Onychiurus*-like species.

Discussion

The absence of ocelli separates this species from other members of the *hammerae* group. The absence of p_1 on all segments of Th.2–Abd.4 is shared only with *narli* which has a slightly more complete chaetotaxy as a_3 is present on Abd.4–5 (Fig. 379).

The assumption that it is p_1 which is absent and not p_2, is only inferred from the general trend seen in other species of the group where p_1 is successively lost forward from Abd.4. A similar reduction in axial chaetotaxy of abdomen is found in *Micranurida* and some *Anurida (subarctica, papillosoides)*, but here always p_2 is lost (Fig. 287).

Distribution and ecology

Only found at two sites near Fairbanks, once in humus/litter under moss in white spruce forest, once in deep layers of partly humified black spruce cones gathered by squirrels (*Tamasciurus douglasi*). – *Total distribution*: Nearctic.

14. **Anurida narli** n.sp.

Figs. 379, 380.

Type locality: Alaska. Barrow.
Type material: Holotype: Female (slide) from "Alaska. Barrow, IBP-site. 30.VIII.1976. Thick moss, lichens, algae in owl mound. A.Fjellberg leg.", at USNM. – *Paratypes:* 2 in same slide as holotype, 1 in separate slide, same data as holotype, at USNM. 1 (slide) from "Alaska. Nome. Primo Sept. 1976. Moss & grass. R.Greenberg leg.", at USNM. 2 (slide) from "Alaska. Cape Krusenstern. 3.IX.1976. Salix litter. R.Greenberg leg.", at MCZ.
Derivation of name: Named after the Naval Arctic Research Laboratory (NARL) in Barrow.

Description

Colour. White (live colour was not noted, but may be yellow).
Size 1.2 mm.

Head. Ant.4 with 3-lobed apical bulb and 6 blunt sensillae, E & F much thinner than others (as Fig. 378. Ocelli usually 3+3, rarely 4+4 or 2+2 (anterior pair fused to a large lens). Individual size and position very variable. Eye pigment was not observed, probably absent. PAO elongate, with 16–32 lobes (Fig. 380). Maxilla and mandible were not examined in detail, but are apparently not different from those of *reducta* (Fig. 376). Labrum/labium as in previous species.

Body. Granulation fine, uniform. Body hairs rather variable, usually short and thin on anterior part of body, notably coarser towards tip of abdomen. Chaetotaxy as in *reducta* (Fig. 374), apart from Abd.4–5 which has a_3 present (Fig. 379).

Also Abd.5 in *narli* has 1 additional short seta p'_4 obliquely behind the macrochaeta p_4. Subcoxae, ventral tube, furca, claws and tenent hairs as in *reducta*.

Discussion

Apart from presence of eyes the species is very similar to *reducta*, separated by details in chaetotaxy (see above). The general morphology is the same in the two species, but abdominal macrochaetae are stronger in *narli*, beeing more distinctly ciliate/serrate.

The species *Anurida brunsvigiensis* Hüther, 1964, described from Germany, resebles *narli/reducta* in absence of p_1 (or p_2) on Th.2–Abd.4. However, thorax has sensilla p_3 in posterior position and p_3 is probably absent on Abd.4. Also maxilla has a much stronger lam.2, reaching far beyond tip of capitulum, and Ant.4 has 8 subequal blunt sensillae.

Distribution and ecology

Only 3 Alaskan samples are seen, all from *N. Slope* (Barrow) and the *Bering Area* (Nome, Cape Krusenstern). A juvenile specimen from Chevak may belong here as well.

The species is collected in moss, grass and *Salix* litter in arctic tundra. Siberian specimens appeared in arctic upland heath and in litter in subalpine thickets of *Alnus fructicosa*. – *Total distribution:* Nearctic – E. Palaearctic (Chukotka: Aborigen, Chaun Bay).

4.5.6 Genus *Paranura* Axelson, 1902

Type species: *Paranura sexpunctata* Axelson, 1902.

Species of this genus are superficially similar to *Anurida*, but differs by absence of PAO and presence of 2 additional sensillae just behind apical bulb of Ant.4 (No.5–6 in Fig. 382. Numeration follows Deharveng 1981). The spine-like sensilla s is absent. The genus is now placed in subfamily Neanurinae.

Key

1. Abdominal macrochaetae acuminate. Ant. 4 apical bulb broad-based, not projecting (Fig. 393) 2
– Abd. 5–6 macrochaetae clavate. Ant. 4 apical bulb strongly projecting, constricted at base (Fig. 394) ..... 4. *sitchensis* n.sp.
2. Th. 2–3 with distance between p_2 setae about 2× as long as a_1–a_1 or p_1–p_1 (Fig. 381). Hair in front of m on Ant. 4 is a normal long hair (as Fig. 394). Furca present as small warts with a few setulae. Tibiotarsal tenent hairs acuminate 3
– Th. 2–3 with distance between p_2 setae only slightly longer than a_1–a_1 or p_1–p_1. Hair in front of m is a small sensilla (Fig. 393). No traces of furca. Median tenent hair weakly clavate ..... 3. *sexpunctata*
3. Ocelli 2+2. White, or at most with dark ocellar spots ..... 1. *quadrilobata*
– Ocelli 3+3. Body with distinct pigment ..... 2. *colorata*

1. **Paranura quadrilobata** Hammer

Figs. 381–385.

Paranura quadrilobata Hammer, 1953:24.

Description

Colour white. A small pigment spot sometimes present under each ocellus.

Size 1.5 mm.

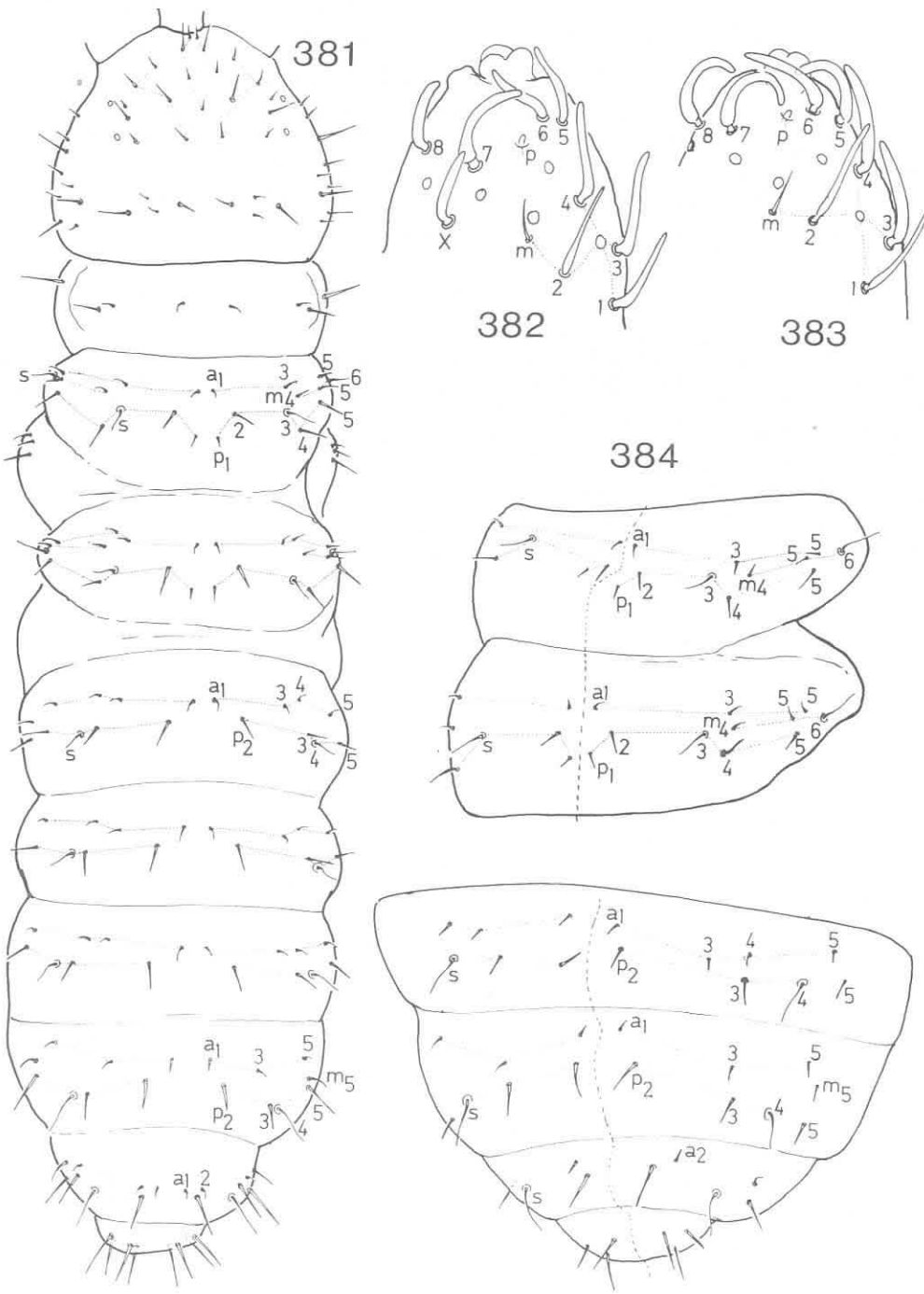
Head Ant.4 with 8 blunt sensillae, S_2 slightly thinner than others. Apical bulb weakly 3-lobed, with broad base (Fig. 383). Ocelli 2+2. Mandible with 2 pointed basal teeth and a long apical tooth which is probably split in a few fine branches. Maxilla styliform.

Body. Chaetotaxy as Fig. 384. Body hairs simple, acuminate. Tenent hairs acuminate.

Discussion

Four syntypes on one slide labelled "Type. Collembola. Canada 1948. Reindeer St. 10. Paranura quadrilobata n.sp. M.Hammer" (Biosystematics Research Institute, Ottawa) were examined and compared with Alaskan/Siberian specimens.

Alaskan specimens differ from the type specimens in several ways: On Ant.4 only sensilla S_2 is slightly thinner than others, in type specimens both S_1 and S_2 are thinner (Figs. 382, 383). On Th.2–3 the sensilla p_3 is moved outwards at level with p_4 or even outside this (Fig. 385), in types clearly inside (Fig. 384). On Th.3 there are 3 setae in front of p_3–p_4, in types there are only 2 (a_4–m_4, Fig. 384). On Abd.4 the macrochaeta p_5 is moved obliquely forward, taking a median lateral position (as Fig. 381, compare type Fig. 384). On



Figs. 381–384. *Paranura quadrilobata*. — 381. Chaetotaxy of specimen from Chaun Bay. — 382. Sensillae of left Ant.4 of Chaun Bay specimen. — 383. Sensillae of left Ant.4, Canadian syntype. — 384. Chaetotaxy of Th.2–3 & Abd.3–6 of Canadian syntype.

Abd.5 seta a_1 is present, a_2 absent. In types a_1 is absent, a_2 present (Figs. 384, 385).

Specimens from NE Siberia (Aborigen, Chaun Bay) are very similar to the Alaskan form, but differ from both this and the types by having one additional X-sensilla on Ant.4 behind S_8–S_9 (Fig. 382). On Abd.5 both a_1–a_2 are present (Fig. 381). On Th.2–3 sensilla p_3 is clearly inside p_4.

The rather frequent individual variation and the small material present, does not permit a detailed discussion of the species. However, the observed differences in separate populations indicate a complex of several morphologically distinct forms. The specimen figured by Christiansen & Bellinger (1980 Fig. 263a) from Pennsylvania differs strikingly by the reduced a-row on Th.2–Abd.3 and represents probably a different species.

Distribution and ecology

Only a few records from the *Bering Area* and *Central Alaska* (Kotzebue, Chevak, Fairbanks, Flood Creek at Richardson Hwy. N of Paxson). Collected in tundra (moss, dwarf birch litter, *Carex/Ledum* with moss and lichens) and taiga (deep litter of white spruce, alder litter). – *Total distribution:* Nearctic – E. Palaearctic (Chukotka: Aborigen, Chaun Bay. See above).

2. **Paranura colorata** Mills

Figs. 386–390.

Paranura sexpunctata var. *colorata* Mills, 1934:28.

Description

Colour spotted bluish-gray. Intensity of pigmentation variable from nearly white to nearly black. Ventral side paler.

Size 1.3 mm.

Head. Ant.4 with a broad-based, weakly 3-lobed apical bulb (Fig.386). All 8 blunt sensillae subequal. Labrum as Fig. 387, but chaetotaxy variable. In extreme cases only 2 basal and the 2 apical setae are present. Ocelli 3+3. Mandible as Fig. 388. Apical tooth split in several short branches. Maxilla styliform, tip of capitulum with 2 small teeth. The 2 ventral lamellae strongly adpressed to capitulum, only visible in squeezed specimens (Fig. 389). Lam.1 simple, lam.2 with a few small apical teeth. A spine-like process, possibly representing lam.3, is present on the dorsal side of the maxilla.

Body. Chaetotaxy as in *quadrilobata* (Fig. 384), though on Abd.4 seta p_3 (rarely absent) is clearly set obliquely in front of sensilla p_4 and also p_5 is moved forward (Fig. 390). In some specimens there is a marked tendency to increased granular size in fields on Abd.4–6 as shown on Fig. 390.

Discussion

Christiansen & Bellinger (1980) signalize the existence of several Nearctic species under the name *colorata.* The Alaskan material appears very uniform and probably represents only a single species, corresponding to the form figured by Christiansen & Bellinger (1980, fig. 262). The Alaskan species has only 3–4 setae on Ant.4 that could be considered "file setae", whereas Christiansen & Bellinger say 16–20 such setae are present. They also give 3.0 mm as maximum size, whereas the Alaskan specimens do not exceed 1.4 mm.

The granular fields shown on Fig. 390 clearly points towards *Neanura* related groups. If *Paranura* really belongs to the plesiomorphic stock of this line (Cassagnau 1980, Rusek 1973), it is interesting to note that *colorata* represents a fairly advanced stage. Abd.5 has a single median tubercle, whereas two separate tubercles (Di–Di) is considered to be the primitive condition (Cassagnau 1980). Possibly there has been an independent parallel evolution in modern *Paranura* and the *Neanura* complex.

Distribution and ecology

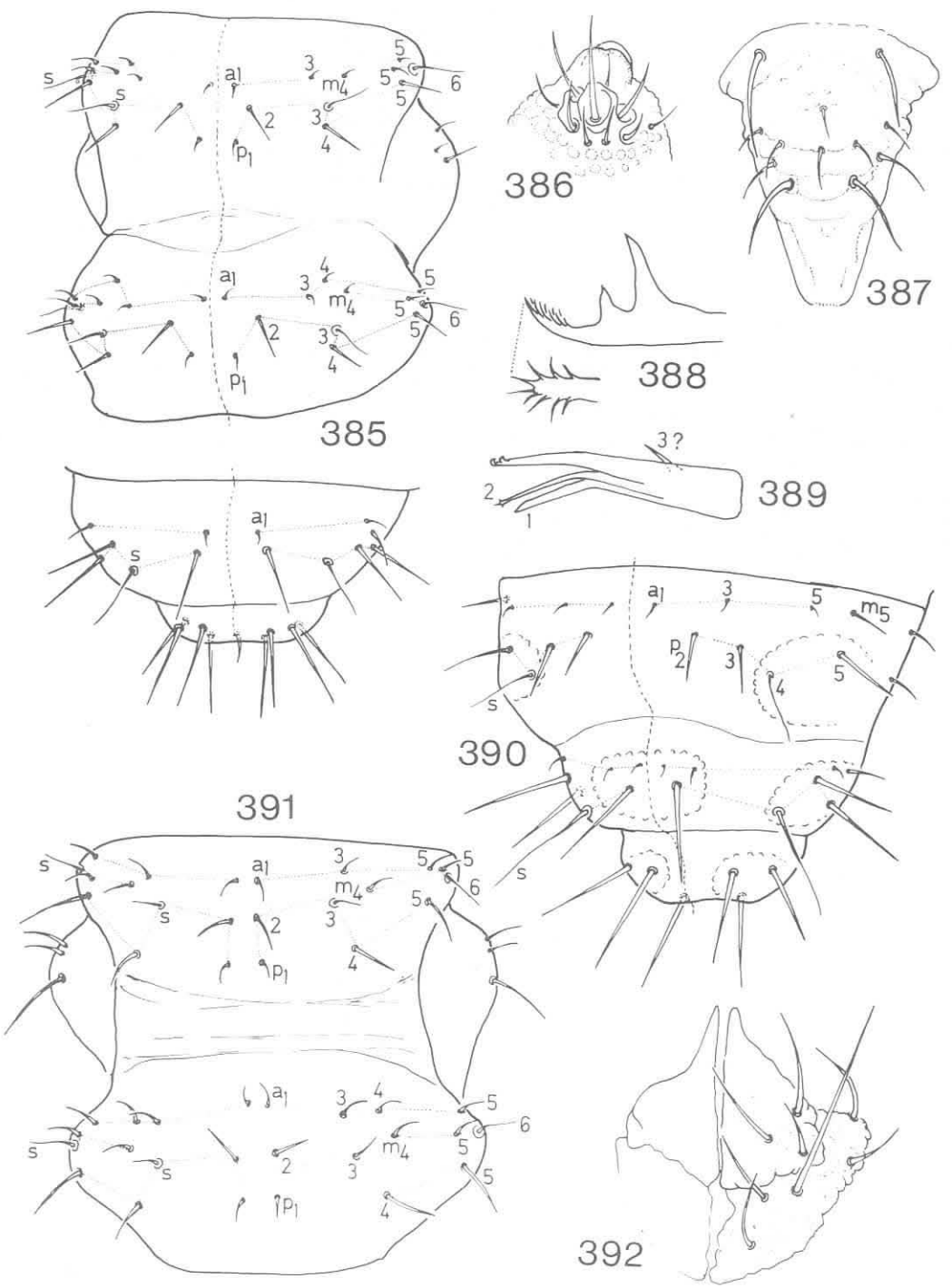
Widespread in the *Aleutian Chain* (Buldir, Adak, Amchitka, Akun) and *SE Coast* (Kenai Peninsula, Semidi Isls., Juneau). Only a single inland record (Fairbanks).

Collected in grassy meadows and coniferous forest litter. Common in damp forests at Juneau, ascending to the lush subalpine *Athyrium* meadows. – *Total distribution:* Nearctic.

3. **Paranura sexpunctata** Axelson

Figs. 391–393.

Paranura sexpunctata Axelson, 1902:102.



Figs. 385–392. — 385. *Paranura quadrilobata*. Chaetotaxy of Th.2–3 & Abd.5–6 of Alaskan specimen. — 386–390. *Paranura colorata*. — 386. Tip of Ant.4, ventral. — 387. Labrum. — 388. Mandible. — 389. Maxilla. — 390. Chaetotaxy of Abd.4–6. — 391–392. *Paranura sexpunctata*. — 391. Chaetotaxy of Th.2–3. — 392. Labium.

Description

Colour white. Eye spots darker, but variable from singularly pigmented ocelli to large confluent spots.

Size 1.6 mm.

Head. Ant.4 with 8 subequal blunt sensillae. The hair in front of m is small, spine-like (Fig. 393). Ocelli 2+2(3). Maxilla and mandible as in *colorata*, Fig. 388. Labrum with 2+2 setae. Labium with 8 setae, 3 in apical part (Fig. 392). Chaetotaxy as in *quadrilobata,* though Abd.5 without a_2. On Th.2–3 the macrochaetae p_2 are moved towards median line and may be mistaken for a m_1 seta (Fig. 391).

Discussion

The Alaskan specimens have been compared to Norwegian material and no great differences were found, except in number of eyes. The European *sexpunctata* has 3+3 ocelli, whereas the Alaskan form normally has 2+2. However, the individual lens size is rather variable, and a single specimen with 2+3 ocelli is seen. Also in Norwegian specimens the eyes are variable and the anterior pair may fuse to a single, large lens. According to Gisin (1960) the species has a 6-toothed mandible. A single Norwegian specimen was dissected and the mandible has 3 teeth as in the Alaskan form. Yosii (1969) has reported *sexpunctata* from Japan, but his figured specimen has a strongly reduced chaetotaxy and probably represents a different species.

Distribution and ecology

Only found under bark on rotten sitka spruce along Montana Creek Trail near Juneau. – *Total distribution:* Holarctic.

4. **Paranura sitchensis** n.sp.

Figs. 394–397.

Type locality: Alaska. Upper Part of Montana Creek Trail (at Miner's Cabin), Juneau.
Type material : Holotype: A reproductive male (slide) from "Alaska. Montana Creek Trail, Juneau. 17.VII.1980. Under bark, dead sitka spruce. A.Fjellberg leg.", at USNM. – *Paratypes:* 1 (slide) as above, at USNM. 2 (slide) as above, except "16.VII.1980", at USNM.

Description

Colour bluish-gray, rather pale. Head darkest. Ocellar field slightly darkened.

Size 1.1 mm.

Head Ant.4 with 8 subequal blunt sensillae. The hair in front of m is a normal, long hair. Apical bulb strongly 3-lobed, projecting, constricted at base (Fig.394). Ocelli 3+3. Labrum with 2+2 setae (Fig. 396). Labium with 8+3 setae, no sensorial papillae in apical part (Fig. 395). Mandible and maxilla as in *colorata* (Fig. 388, 389), apex of mandible spilt into two or more short branches. Chaetotaxy as Fig. 397 B. Th.1 with 3+3 setae. Macrochaetae on Abd.5–6 clavate, sometimes rather indistinct. Furca reduced to a small hump with 4+4 setulae. Ventral tube with 4+4 setae. Claws without teeth. Dorsomedian tenent hair acuminate or blunt.

Discussion

The clavate abdominal hairs and the constricted apical bulb on Ant.4 separate the species from other Nearctic members of the genus. From the related *sexpunctata* it differs by stronger pigmentation, longer sensillae on thorax and abdomen and a full set (11) of labial setae (8 in *sexpunctata*). Yosii (1972) has reported a Japanese form of *sexpunctata* with clavate abdominal hairs. It may be identcal or related to the present form.

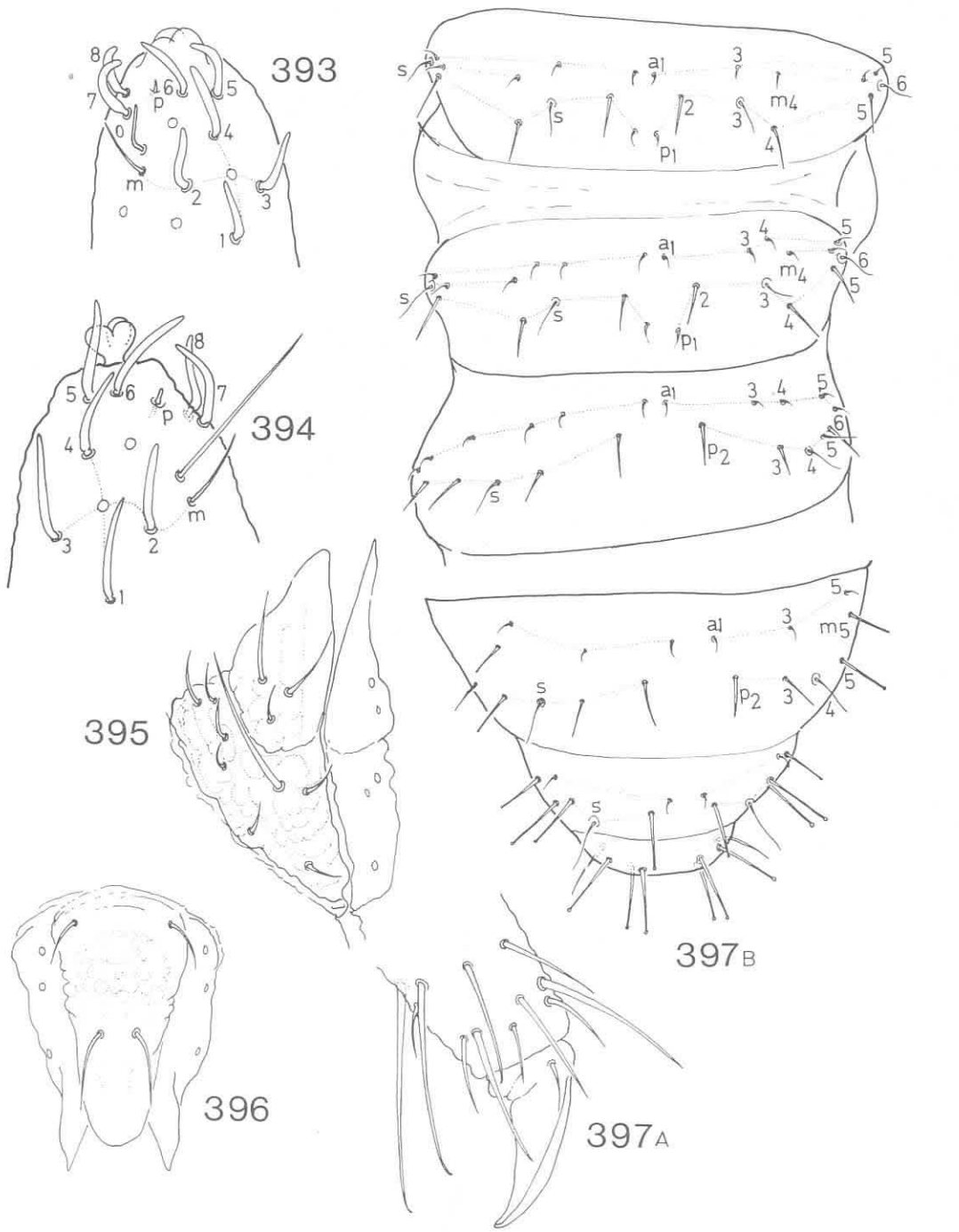
Distribution and ecology

Only found at Juneau under bark on dead sitka spruce, in company with *P. sexpunctata*. In 1983 a fairly large number of specimens were collected under bark of fallen conifers on Vancouver Island (Goldstream Prov. Park, Pacific Rim Nat. Park). – *Total distribution:* Nearctic.

4.5.7. Genus *Morulina* Börner, 1906

Type species: *Anura gigantea* Tullberg, 1876

The large species of this genus are among the most conspicuous Collembola to be met with in the Arctic. The peculiar tuberculate/papillate PAO (Fig. 404) – also called moruliform – is found in no other Alaskan genera.



Figs. 393–397. — 393. *Paranura sexpunctata*. Sensillae of left Ant.4. — 394–398. *Paranura sitchensis* n.sp. — 394. Sensillae of right Ant.4. — 395. Labium. — 396. Labrum. — 397A. Tip of right T.1. — 397B. Chaetotaxy of Th.2–Abd.1 & Abd.4–6.

1. **Morulina gigantea** (Tullberg)

Figs. 398–400.

Anura gigantea Tullberg, 1876:41.
Morulina kotzebuensis Bödvarsson, 1960:48.

Type locality: USSR. Siberia. Jefremov Kamen (72°40'N) at mouth of river Jenisej.
Type material: Lectotype: One specimen, 2.7 mm (alc., mouthparts and one leg on separate slide) labelled "Riksmuseets Entomologiska Afdelning. Anura gigantea Tullb., Siberien 4, Colleg. Jenisejexp. 75. Determ. T.Tullberg", at Naturhistoriska Riksmuseet, Stockholm. According to Holm (1973), locality no.4 of the Swedish 1875 Jenisej expedition is Jefremov Kamen, which is also mentioned by Tullberg (1876:41) as one of the localities in which *gigantea* was found. – *Paralectotypes:* 20 (alc.) from lectotype sample, 3 (alc.) from loc. no. 14 (Verschinisk, 68°55'N), 14 (alc.) from loc. no.25 (S of Troitskoj, 65°45'N) and 1 (alc.) from loc. no.6 (Sopotschnaja Korga, 71°55'N), all deposited with lectotype.

Description

Colour reddish or violet brown with darker tubercles.

Size 3.5 mm.

Head. Mandible with 6 teeth, basal tooth broad-based (Fig. 398). Maxillary capitulum with 3 apical teeth, basal part with 2 strong spines. Lam.1 simple or slightly hooked at apex, Lam.2 split into 2–5 slender apical branches (Fig. 399).

Chaetotaxy rather variable due to a moderate plurichaetosis.
Head. Di+Di: 5-7, Dl: 8-9, So+L: 16±, Oc: 5-6, Cl: 6-8, An: 5, Fr: 2-3.
Postcephalic:

		Di	De	Dl	L
Th.	1	3–5	6–12	7– 8	–
	2	5–6	7–10	9–10	10
	3	5–6	8–9	10	10
Abd.	1	4–6	7–8	4	10
	2	4–6	7–8	5	13
	3	4–6	7–8	5	15
	4	3–5	8–12		15
	5	13–16			12±

Ventral tube with 13–16 setae. Furca reduced to 2 humps with 1–2 setae each. Body tubercles as in *mackenziana* (Fig. 405), apart from Abd.4 which has De+Dl completely fused (Fig. 400). Claws with distinct inner tooth.

Discussion

As several species might be covered by Tullberg's brief original description of *gigantea*, the type material was consulted and a lectotype designated. The type area, the Jenisej region, has indeed more than one species of *Morulina*. Two samples collected by the Swedish 1876 expedition from Tolstoinos (70°10'N) and Nikandrovska Island (70°40'N) are mixtures of *gigantea* s.str. and another species having multidentat mandibles like *mackenziana* but differing from that species by dentate claws and fused De+Dl tubercles on Abd.4. The macrochaetae are strongly ciliate.

Bödvarsson (1962) described the new species *kotzebuensis* from Kotzebue. I have examined 4 paratypes kept in Zool. Mus., Lund. Chaetotaxy of thorax and tubercles on Abd.4 are as in *gigantea*. Head was dissected on 1 specimen, showing typical *gigantea* maxilla and mandible. Bödvarsson's (1960, fig. 3c) odd figure of maxilla is probably drawn from a badly squeezed specimen.

Distribution and ecology

Many records from *N. Slope* (Lonely at Smith River, Barrow, Meade River) and the *Bering Area* (Wales, Kotzebue, Cape Krusenstern, St. Paul in the Pribilof Isls.). Only one record from *Central Alaska* (Kanuti River S of Old Man Camp).

The species is abundant in rather damp tundra habitats. Often seen on the under side of boards and other debris along the arctic shores. – *Total distribution:* Nearctic – E. Palaearctic (verified specimens from Jenisej, Ostrov Belyj at mouth of river Ob, Chaun Bay, Pitlekaj (Chukotka)).

2. **Morulina thulensis** Hammer

Figs. 401, 402.

Morulina thulensis Hammer, 1953:31.

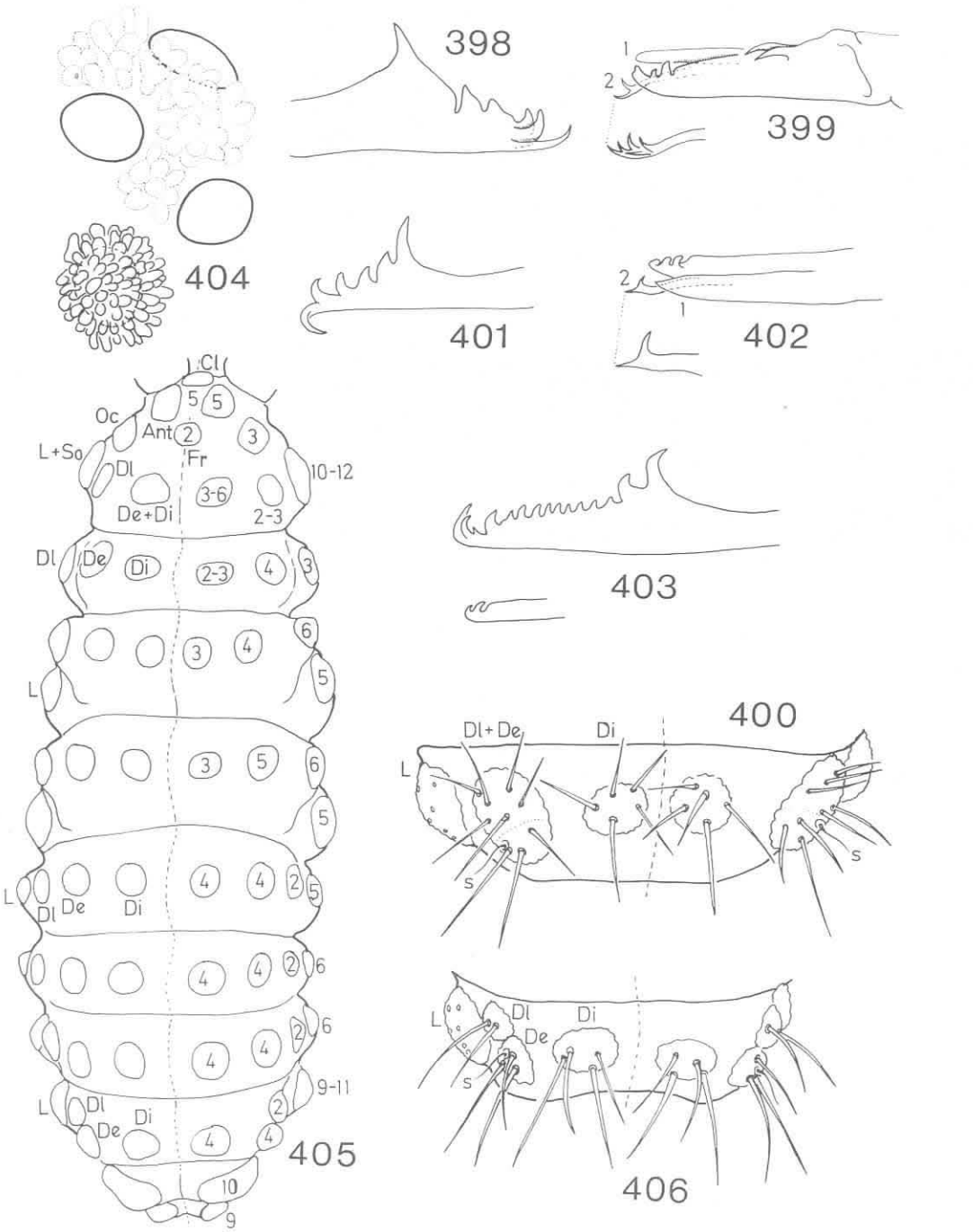
Description

Colour bluish-gray.

Size 2.5 mm.

Head. Mandible with 6 teeth, basal tooth narrow-based (Fig. 401). Maxillary capitulum with 3 apical teeth. Lam.1 simple, membraneous. Lam.2 with 2 short apical branches (Fig. 402).

Chaetotaxy variable due to plurichaetosis.



Figs. 398–406. — 398–400. *Morulina gigantea*. — 398. Mandible. — 399. Maxilla. — 400. Chaetotaxy of Abd.4. — 401–402. *Morulina thulensis*. — 401. Mandible. — 402. Maxilla. — 403–406. *Morulina mackenziana*. — 403. Mandible with apex of maxilla below. — 404. Left PAO and ocelli. — 405. Arrangement of dorsal tubercles and number of setae. — 406. Chaetotaxy of Abd.4.

Head. Di+De: 7–11, Dl: 5–8, So+L: 16±, Oc: 4–5, Cl: 5–8, An: 5–7, Fr: 2.
Postcephalic:

		Di	De	Dl	L
Th.	1	3–7	10–14	9–12	–
	2	7–9	9–14	11	11–15
	3	6–10	10–13	10–12	13–20
Abd.	1	6–9	9–15	7–9	11–14
	2	7–8	8–15	7–9	13–18
	3	7–9	9–13	7–11	14–22
	4	6–10	3–6	9–13	18–12
	5	⟵	16–18	⟶	19±

Abd.4 with tubercles De and Dl touching, but not fused. Claws with distinct inner tooth.

Discussion

The species resembles *gigantea*, but is macroscopically identified by the separate Abd.4 De–Dl tubercles. The small basal tooth of mandible is a definite diagnostic character.

Distribution and ecology

The most common *Morulina* in Alaska, collected in all principal parts except extreme north, the Aleutians and SE Coast. *N. Slope* (Franklin Bluffs, Toolik Lake, Meade River), *Brooks Range* (mts. W of Atigun Camp, "Last Spruce S of Chandalar, Sukakpak Mt. S of Dietrich Camp), *Central* (Gobbler Knob S of Prospect Camp, Kanuti River S of Old Man Camp, Spinach Creek and Washington Creek at Fairbanks, Mastodon Dome, Eagle Summit, Eagle Creek, Delta), *Bering Area* (Kotzebue), *Alaska Range* (Flood Creek at Richardson Hwy. N of Paxson, Denali Hwy. – several places, Watana Mt. in Talkeetna Mts., Thompson Pass in Chugach Mts., Northway).

Usually found in damp habitats (bogs, wet meadow, moist litter in river bank thickets, rotten logs etc.). – *Total distribution:* Nearctic.

3. **Morulina mackenziana** Hammer

Figs. 403–406.

Morulina mackenziana Hammer, 1953:52.

Description

Colour dark bluish-gray, often nearly black. Generally darker than other Alaskan species.

Size 2.0 mm.

Head. Mandible prolonged, with 10–15 teeth (Fig. 403 above). Maxillary capitulum with 2 hook-like apical teeth (Fig. 403 below). Lamellae as in *thulensis* (Fig. 402).

Chaetotaxy rather simple, less variable than in other species.

Head. Di+De: 3–6, Dl: 2–3, So+L: 10–12, Oc:3, Cl:5, An:5, Fr: 2.
Postcephalic:

		Di	De	Dl	L
Th.	1	2–3	4	3	–
	2	3	4	6	5
	3	3	5	6	5
Abd.	1	4	4	2	4–5
	2	4	4	2	5–6
	3	4	4	2	6
	4	4–5	4	2	9–11
	5	⟵	10	⟶	

Abd.4 with tubercles De and Dl touching, but not fused (Figs. 405, 406). Claws without or with minute inner tooth.

Discussion

In mixed samples of *mackenziana* and other species, the former will usually be recognized by its darker colour. The simpler chaetotaxy and multidentate mandibles are decisive characters.

Distribution and ecology

Only a few records from N and Central Alaska (shore of Toolik Lake, hills E of Toolik Camp, Franklin Bluffs, Ft. Yukon). Collected in litter of spruce, alder and willows. The N. slope specimens appeared in bogs and moss/lichen/*Dryas* tundra (rather dry). – *Total distribution:* Nearctic.

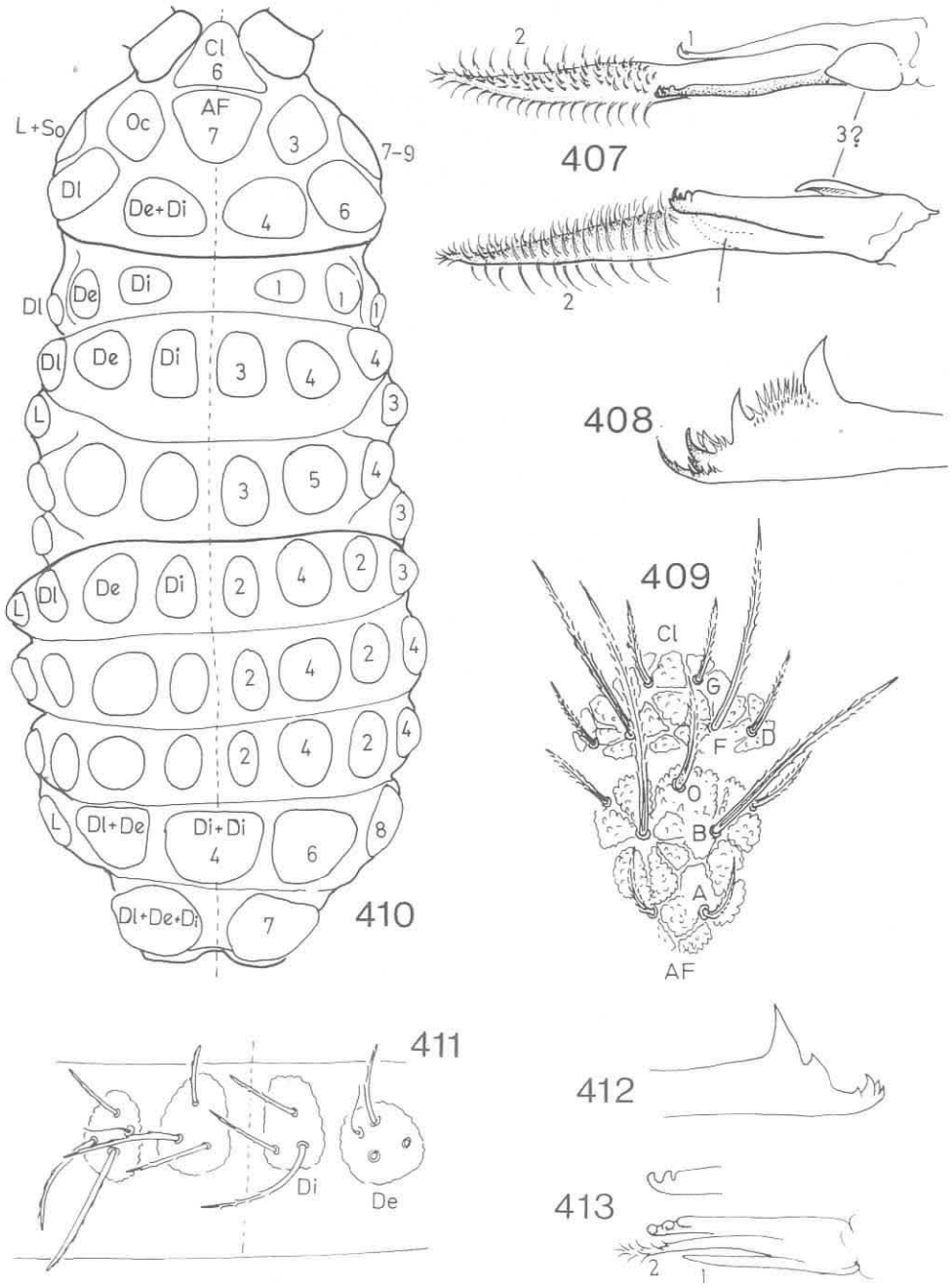
4.5.8. Genus *Morulodes* Cassagnau, 1955

Type species: *Morulodes millsi* Cassagnau, 1955

1. **Morulodes serratus** (Folsom)

Figs. 407–411.

Neanura serrata Folsom, 1916:511.
Kodiakia prima Bödvarsson, 1960:43, n.syn.
Kodiakia aleuta Bödvarsson, 1960:46, n.syn.



Figs. 407–413. — 407–411. *Morulodes serratus* — 407. Left maxilla. — 408. Mandible. 409. Chaetotaxy of central part of head. — 410. Arrangement of dorsal tubercles and number of setae. — 411. Median part of Th.2 of paratype from Kodiak. — 412–413. *Christobella ornata*. — 412. Mandible. — 413. Maxilla.

Description

Colour dark bluish-gray.

Size 2.1 mm.

Head. Ocelli 4+4 (3 anterior, 1 posterior). Maxilla strongly developed, lam.2 often projecting out of the mouth. Lam.2 with 2 rows of long, curved filaments along the "back" and numerous shorter, curved filaments on the inner side. Lam.1 simple, curved. Apex of capitulum reduced, with 1–2 strong, dark apical teeth followed by a few hyaline, irregular subapical teeth. A membraneous "wrap" around base of capitulum may represent lam.3 (Fig. 407). Mandible with many small, sharp denticles in addition to the primary teeth (Fig. 408).

Chaetotaxy. Arrangement of tubercles and number of setae as in Fig. 410. The antennal and clypeal fields on head as Fig. 409.

Discussion

The identification of the Alaskan species is based upon the description of Christiansen & Bellinger (1980). Bödvarsson (1960) described the two species *Kodiakia prima* and *K. aleuta* from Kodiak and Unalaska, respectively. Christiansen & Bellinger (1980) indicate that these two species may be synonyms of *serratus*. Paratypes of *prima* and *aleuta* (Zool. Mus., Lund) have been examined and I can find no differences in chaetotaxy and arrangements of tubercles on thorax and abdomen between *prima/aleuta* and specimens of *serratus*. Notably all species have 3+3 setae on the median pair of tubercles on Th.2, contrasting the original description of *prima/aleuta* which states 1+1. According to Christiansen & Bellinger (1980) *prima/aleuta* differ from *serratus* in having fused dorsointernal tubercles on Abd.5. This must be a misinterpretation of the original description which reads: "Abd.5 has 1+1 large, composite tubercles, distinctly separated medially–" (Bödvarsson 1960 p. 43). Abd.5 of the paratypes are as originally described and figured, and do not differ from Christiansen & Bellinger's figure of *serratus*.

Unfortunately the paratypes of *prima/aleuta* are without heads so the mouth parts could not be checked. Until the mandibular differences indicated by the original description are verified, it seems most appropriate to sink these two taxa to junior synonyms of *serratus*.

Distribution and ecology

Only found in the *Bering Area* (Probilof Isls.), *Aleutian Chain* (Buldir, Amchitka, Adak, Atka, Akun, Semidi Isls.) and the *SE Coast* (Homer, Juneau). The Aleut specimens were collected in meadow communities, both wet and dry. The Homer specimens appeared in litter of spruce and willows. Seven records from the Juneau area were all made in subalpine/alpine meadows (3,000 – 4,000 ft). – *Total distribution:* Nearctic (Pacific coast).

4.5.9 Genus *Christobella* n.gen.

Type species: *Neanura ornata* Folsom, 1902.

Diagnosis: Ocelli 2+2 or 3+3. Dark pigment only in eyes. Head with tubercles Cl, Af and Oc fused to a single mass. The posterior tubercles Di+De fused or weakly separeted along median line of head. Also the lateral Dl, L and So fused. Abd.4 with the median Di+Di fused, and on each side De+Dl are fused. Abd.5 with all tubercles Di, De and Dl fused into a single mass, or weakly separated in 2 halves along median line of the tergite. Maxilla with 2–3 apical teeth and 2 lamellae, 1 simple and 1 with several apical branches.
Derivation of name: Named after Christiansen & Bellinger, the authors of the current standard work on Nearctic Collembola.

Christobella ornata (Folsom)

Figs. 412–416.

Neanura ornata Folsom, 1902:89.

Description

Colour White, except the 3+3 ocelli which are blue.

Size 1.5 mm.

Head. Ant.4 with 8 subequal blunt sensillae. Labrum with 2–2–2 setae. Maxilla as Fig. 413. Mandible with 3–4 small apical teeth set in an oblique row, and 2 large, more membraneous basal teeth (Fig. 412). Arrangement of tubercles as Fig. 416.

Chaetotaxy of head as Fig. 416.
Postcephalic (Fig. 415):

		Di	De	Dl	L
Th.	1	1	2	1	–
	2	3	4–5	4	3
	3	3	4–5	4	3
Abd.	1	2	4	2	3
	2	2	4	2	4
	3	2	4	2	4
	4	2	6		6
	5	7			

No free setae. Abd.6 more or less hidden by Abd.5. Ventral tube with 3–4 setae on each side. Furca present as a small hump with 3+3 setulae. Claws with distinct inner tooth.

Discussion

As a result of the new generic classification of Cassagnau (1979, 1980), it was impossible to place Folsom's *Neanura ornata* in any known genus. It comes close to *Pumilinura* Cassagnau and *Monobella* Cassagnau, but differs from both these genera by its unique arrangement of body tubercles. It is similar to *Pumilinura* by the fused Di+Di tubercles on Abd.4 and the fused Abd.5 tubercles, but *Pumilinura* has separate Cl, Af and Oc on head and separate De–Dl on Abd.4. *Monobella* has the same fusion of Abd.5 tubercles and the Cl–Af–Oc on head, but differs by having Dl separated from L+So on head and a different arrangement of Abd.4 tubercles (the central field includes all Di, De and Dl, in *Christobella* the central field consists of only Di+Di). Christiansen & Bellinger (1980) placed *ornata* in *Lathriopyga* Caroli, a genus which has the same fusion of Cl–Af–Oc on head. However, in *Lathriopyga* Abd.4 has De separated from Dl and on Abd.5 the central field consists of only the fused Di+Di, De–Dl are separated.

Five specimens from Washington (coniferous litter along trail to Ingalls Lake, Wenatchee Mts., 23.VIII.1980. A.Fjellberg leg.) differ from the Alaskan form by having only 2+2 ocelli and by having the large Di–De tubercle on head and the Di–De–Dl tubercle on Abd.5 separated in two halves along median line. Also the deep cuticular reticulation and the cryptopygy is less marked. Chaetotaxy is identical to *ornata*. They may represent a different, more plesiomorphic species.

Distribution and ecology

Many records from the *Aleutian Chain* (Buldir, Amchitka, Akun, Adak, Semidi Isls.) and the *SE Coast* (Homer, Turnagain Pass on Kenai Pensinsula, Sitka (type loc.)). The species is frequent in various meadow communities and is often found together with *Morulodes serratus*. – *Total distribution:* Nearctic.

4.5.10 Genus *Neanura* MacGillivray, 1893

Type species: *Achorutes muscorum* Templeton, 1835

1. **Neanura (Deutonura) frigida** Yosii

Fig. 417.

Neanura frigida Yosii, 1969:537.

Description

Colour white (live specimens pale yellow) with a small blue spot under each ocellus.

Size 1.6 mm.

Head. Ant.4 with 8 subequal blunt sensillae. Ocelli 2+2. Mandible apparently 3-toothed, but apical tooth split in 5–6 short filaments. Maxilla styliform, capitulum with 2 small apical teeth. One narrow lamella with 2–3 apical hooks pass beyond tip of capitulum. Tubercles arranged as on Fig. 417. On head Di+De are fused on each side, broadly separated along median line. A large central tubercle on Abd.5 consists of the fused Di+De.

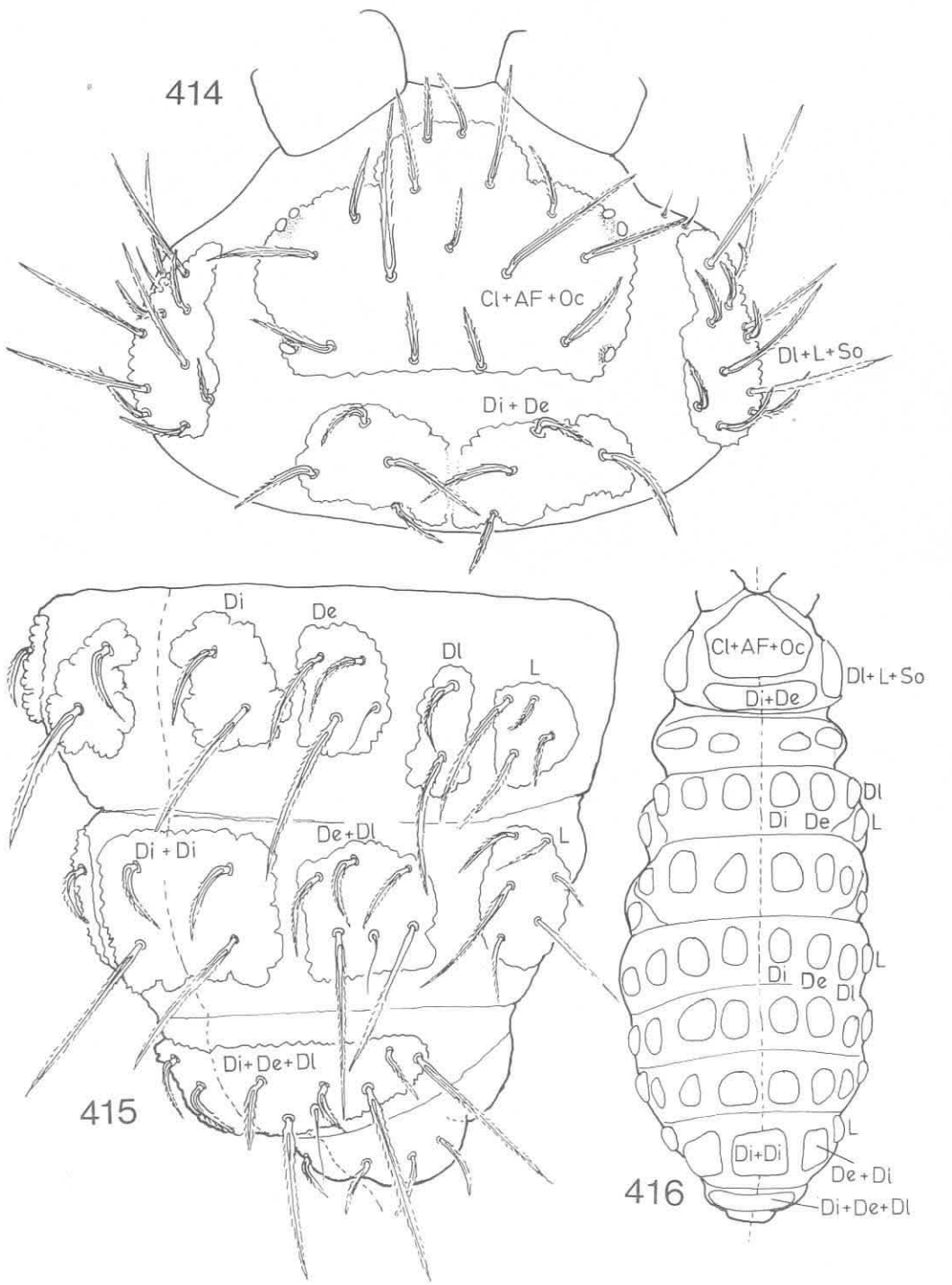
Chaetotaxy as Fig. 417.

Head with Cl: 4, Af: 7, Oc: 3, Di+Di: 4, Dl: 6, L+So: 7-9.

Postcephalic:

		Di	De	Dl	L
Th.	1	1	2	1	–
	2	3	3	4	3
	3	3	3	4	3
Abd.	1	2	3	2	3
	2	2	3	2	3
	3	2	3	2	4
	4	2	3	3	7–8
	5	6		8	

The Di tubercles not developed on Th.1. Free setae: a_3 on Th.3 – Abd.3. The free setae are highly variable in size, from a tiny setula to a normal, short macrochaeta. One or two additional



Figs. 414–416. *Christobella ornata*. — 414. Chaetotaxy of head. — 415. Chaetotaxy od Abd.3–6. — 416. Arrangement of dorsal tubercles.

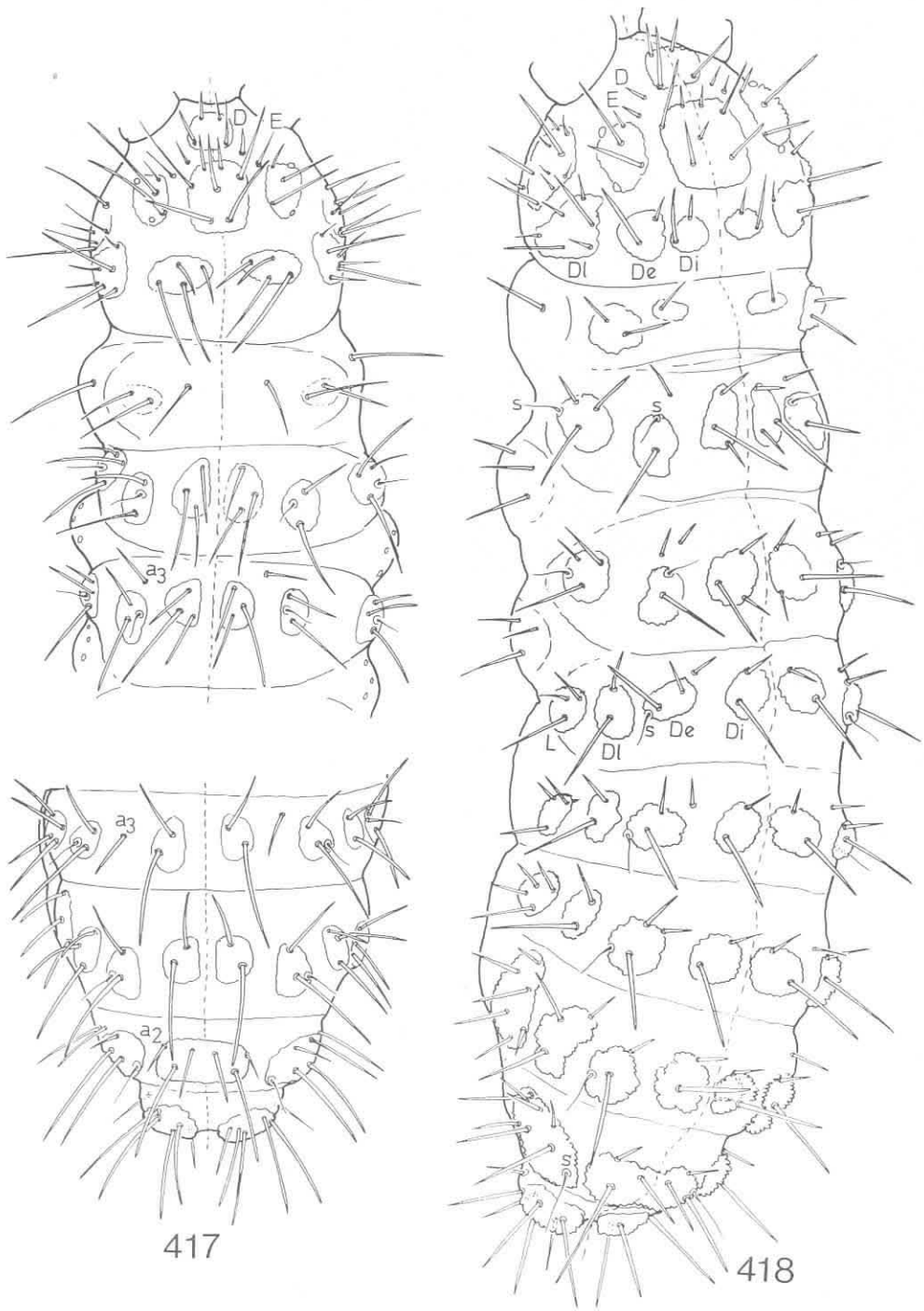


Fig. 417. *Neanura (Deutonura) frigida*. Chaetotaxy of Head–Th.3 & Abd.3–6. — 418. *Neanura (Endonura) tundricola* n.sp. Chaetotaxy.

free setae may be assymetrically present. Also a_2 on Abd.5 is variable in size.

Discussion

The species readily falls into the subgenus *Deutonura* Cassagnau characterized by the fused Di+Di on head and the fused Di pair on Abd.5. The Alaskan specimens do not deviate from the original description of Yosii (1969). The systematic position of the species remains unclear as a detailed analysis of the Nearctic *Neanura* has not yet been made.

Distribution and ecology

Many records from *Central Alaska* (Fairbanks area, Twelve Mile Mt. on Steese Hwy., Mastodon Dome. Eagle Summit, Eagle Creek) north to *Brooks Range* (Sukakpak Mt. S of Dietrich Camp), *Aleutian Chain* (Buldir, Atka, Akun, Adak, Amchitka) *SE Coast* (Juneau).

Common in forest litter in the central taiga, ascending to alpine meadows (1,200 m). Some records are from rather dry sites (*Dryas* cushions on exposed cliffs, dry litter of *Populus/Rosa/Shepherdia* on S-exposed hillside) – *Total distribution:* Nearctic (Alaska, Canada) – E. Palaearctic (Japan, Chukotka: Aborigen, Chaun Bay). The Canadian record is that of Hammer (1953) published as *Neanura quadrioculta* Guthrie. I saw a singel specimen from Mackenzie Delta mounted on the same slide as the type specimens of *Paranura quadrilobata.*

2. **Neanura (Endonura) tundricola** n.sp.

Fig. 418.

Type locality: Alaska. Toolik Lake N of Brooks Range. *Type material: Holotype:* One specimen (alc.) from "Alaska. Toolik Lake N of Brooks Range. 19.VIII.1976. Salix litter. A.Fjellberg leg.", at USNM. – *Paratypes*: 1 (alc.) from holotype sample , at USNM. 3 (slide) as above, except "Dry moraine, moss, lichens, Arctostaphylos.", at USNM. 1 (alc.) as above, except" 15.VIII.1976. Moss & grass at shore of Lake", at USNM. 1 (slide) as above, except "18.VIII.1976. Wet meadows on SW slope. Rich flora"., at USNM. 4 (3 alc., 1 slide) from "Alaska. Kotzebue. July 1980. Moss, lichens, Ledum, Carex. Tundra. P.Blanchard leg.", at USNM. 18 (alc.) from "Alaska. "Last Spruce" S of Chandalar. 20.VIII.1976. Moist litter in tall alder-willow thicket along river. A.Fjellberg leg.", at USNM. 3 (slide) as above, at MCZ. 29 (28 alc., 1 slide) from "Alaska. Below Gobbler Knob S of Prospect Camp. 20.VIII.1976. Alnus litter in moist birch/lichen slope. V.Behan leg.", at USNM. 5 (slide) from "Alaska. Aleutian Isls. Buldir. 26.IX.1976. Grass covered talus, 1,050 ft. ? leg.", at BM. 2 (slide), as above, at USNM. 2 (slide) from "Alaska. Cape Thompson. Ogoturuk Creek Basin. 7–11.VII.1980. Moss, tussock tundra. D. & B.Murray leg.", at BM. 1 (slide) from "Alaska. Nome. Primo Sept. 1976. Moss & grass. R.Greenberg leg.", at BM. 2 (slide) from "Alaska. Norton Bay. Inglutalik River. 18.VIII.1976. Upland. Moss, Carex, Vaccinium, lichens. ? leg.", at USNM. 1 (slide) from "Alaska. Chevak in Yukon/Kuskokwim Delta. 4.VII.1976. Dry upland with *Empetrum, Ledum,* lichens. T.Seastadt leg.", at AF. 1 (slide) from "Alaska. Nunivak Isl., Duchikthluk Bay. 19.IX.1976. *Empetrum, Carex, Vaccinium*, lichen tundra. P. Michelson leg.", at MCZ.
Derivation of name: The name *tundricola* is used because of the presence of the species in the arctic tundra, a most unusual habitat for members of the genus *Neanura.*

Description

Colour spotted bluish-gray, pale. Ventral side nearly white.

Size 1.3 mm.

Head Ant.4 with 8 subequal blunt sensillae. Ocelli 2+2. Labrum with 2–2–2 setae. Maxilla styliform. Mandible with 3 teeth, apical tooth split in 3–4 fine filaments

Body with slender, acuminate macrochaetae which are surrounded by a membraneous sheet.

Chaetotaxy. Arrangment of dorsal tubercles and chaetotaxy as Fig. 418.

Head. Cl: 4, Af: 7, Oc: 3, Di: 2, De: 2, Dl: 6, L+So: 8–9. Free setae: D & E.

Postcephalic:

		Di	De	Dl	L
Th.	1	1	2	1	–
	2	3	2	4	3
	3	3	2	4	3
Abd.	1	2	3	2	3
	2	2	3	2	3
	3	2	3	2	4
	4	2	3	3	6–9
	5	⊢—6—⊣		⊢—8–9—⊣	

In addition the following free setae are present: One in front of De on Th.2, two in front of De on Th.3, one in front of De on Abd.1–3 (sometimes more or less incorporated in De on Abd.2–3). On Abd.5 a_2 is variable in size from a tiny setula to a small macrochaeta. Abd.6 clearly visible from above. Ventral tube with 4+4 setae. Furca reduced to a small hump with 4–5 setae. Claws simple, without teeth.

Discussion

The species fits easily into subgenus *Endonura* Cassagnau by the fused Di+Di on Abd.5 and the separate Di–De tubercles on head. The free D and E setae on head separates *tundricola* from most other species of *Endonura*. It comes close to the European *dalensi* Deharveng, but this species has no pigment.

Distribution and ecology

Many records from the *Aleutian chain*, the *Bering Area* and southern and northern foothills of *Brooks Range* (see type material). Unlike the previous species, it was not found in the rich taiga in Central Alaska. Most records are from tundra, meadows and litter in alder/willow thickets. – *Total distribution:* Nearctic.

5. Distributional patterns of Alaskan Collembola

A full treatment of this topic can first be made when material of the other collembolan families are worked out. However, some patterns are already evident from the distribution of podurids and will be briefly discussed in the following section.

a. Arctic (Eskimoan): *Hypogastrura denali* form C, *H. sensilis, H. concolor, H. tullbergi, H. devia, H. longispina, H. brevis* complex, *H.*cf. *czukczorum, Bonetogastrura variabilis, Willemia scandinavica, W. granulata, Brachystomella parvula, Friesea quinquespinosa, Anurida decemoculata, A. similis, A. narli, Morulina gigantea, M. mackenziana, Neanura tundricola.*

Several of these species are also present in the Bering Area and the Aleutian Isls. (*H.* cf. *czukczorum, W. scandinavica, F. quinquespinosa, A. narli, M. gigantea, N. tundricola*). Of the 19 species classified as Arctic, 8 are Holarctic. A further 5 species are Amphiberingian, present also in NE Siberia. Thus a substantial portion of the Arctic species are distributed across the Bering Strait, a situation also found in other arthropod groups (Behan 1978, Danks 1981).

b. Hudsonian: *Xenylla canadensis, X. betulae, Frisea alaskella, Pratanurida tananensis, Micranurida porcella, Anurida interior, A. papillosa, A. subarctic, A. reducta.*

As most species in this group are new species, only fragments of their total distribution are probably known. Only 2 of the species are found in NE Siberia so far. The abundance of some of the species in Central Alaska indicates that their range extend into Yukon and possibluy further east into the Hudsonian region.

c. Brooks Range/Alaska Range: *Hypogastrura denali* form A & B, *H. isabellae.*

The higher mountains of Alaska have a characteristic Collembola fauna with a number of new species, particularly in Isotomidae. Some of them are certainly endemics, others may be northern extensions of the general Cordilleran fauna or belong to an Amphiberingian group. The present *H. isabellae* was also found in mountains at Aborigen in Chukotka (like *Isotoma komarkovae* Fjellberg, originally described from Brooks Range (Fjellberg 1978)).

d. Pacific coastal (Sitkan): *Hypogastrura krafti, H. wallmoi, Schaefferia duodecimocellata, Microgastrura minutissima, Pseudachorutes* cf. *indiana, Paranura colorata, P. sexpunctata, P. sitchensis, Morulodes serratus, Christobella ornata.*

e. Aleutan. A definite Aleutan element could not be demonstrated in the present material. The species here identified as *Hypogastrura helena* and *H. pecki* appear widespread in the Aleutian Chain and Bering Area. Some of the above species classified as Pacific Coastal are particularly abundant in the Aleutian Chain (*Morulodes serratus, Christobella ornata*). A distinction between Sitkan and Aleutan elements in the collembole fauna seems not possible at present.

f. Generally distributed species. A large group of species of which some are mainly northern (Arctic/Hudsonian), like *Hypogastrura pannosa, H. tooliki, H. macrotuberculata, H. palustris, Anurida weberi, A. hammerae, A. beringi.* Others are mainly southern (Hudsonian/Pacific): *Hypogastrura oregonensis, Xenylla humicola, Neanura frigida.* A number of species are found all over the state: *Podura aquatica, Hypogastrura armata, H. brevisensillata, H. denticulata, H. vulgaris, Willemia denisi, W. similis, Odontella coronifer, Xenyllodes armatus, Friesea mirabilis, F. claviseta, Pseudachorutes* cf. *subcrassoides, Micranurida pygmaea, M. valiana, Anurida papillosoides, A. polaris, A. martynovae, Morulina thulensis.* Among these are species with a large Holarctic or world wide distribution.

g. Introduced species: *Hypogastrura distincta, H. ripperi.*

6. General conclusions concerning the Alaskan Collembole fauna

A substantial part of the Alaskan podurids belong to the genus *Hypogastrura* s.lat. (32 spp.) which is well represented in arctic/alpine and northern sites in general. In suitable habitats they often outnumber other species by individuals, and their abundance was frequently noted even by eye-sight in field. This may indicate that members of the genus are particularly well adapted to barren land conditions. So far there has been few biological studies to support this view. Addison (1981) found that *Hypogastrura concolor (tullbergi* auct.) in Arctic Canada had a prolonged life span with ability to grow at low temperatures and overwinter in any stage of development. But, as was also noted by her, these appear to be general characteristics of many invertebrates and not peculiar to *Hypogastrura* (MacLean 1975).

More likely, the high diversity of *Hypogastrura* in the Arctic are explained by the evolutionary history of the group. Unfortunately the taxonomic conditions are such that a detailed analysis of the distribution of individual taxa is not possible, but there is little doubt that the majority of *Hypogastrura* species are northern (Salmon 1964, Bourgeois & Cassagnau 1972). I do not feel confident to enter into the hot debate about evolutionery centres (Nelson & Rosen 1979) by geographical fixation of any such in Collembola, but it is hard to avoid the idea that a major part of the *Hypogastrura* complex evolved under cold temperate/arctic conditions. The absence of *Hypogastrura* with genuine Hudsonian distribution in Alaska is probably significant in this context.

Even more striking is the abundance of Alaskan species in the *Anurida* complex. Christiansen & Bellinger (1980) list a total of 16 *Anurida* species from North America. If the same broad generic concept is applied, the present work uncovered no less than 20 species in Alaska, of which 11 are new species. Most of these species (11) are Amphiberingian or have a wider Holarctic distribution. Within Alaska they are well represented in the Arctic and Hudsonian provinces, some are particularly common in the richer interior taiga. Work in progress has revealed additional new species in NE Siberia and northern Cordillera (Fjellberg 1984c). All this points to a very rich *Anurida* fauna in northern areas. Whether this richness in species has its centre in Beringia or not, is too early to say.

Apart from the Arctic species of *Morulina*, members of the subfamily Neanurinae appear to be concentrated along the Pacific coast including the Aleutian Islands. This probably reflects a more southern evolutionary intensity in Neanurinae than in the groups discussed above. The same pattern is seen in Europe where recent revisionary work has uncovered a highly diversified fauna in the Mediterranean region (Cassagnau 1979, Deharveng 1979). The N. American Neanurinae are still in a premature taxonomic state. The same is true about Asiatic Neanurinae, but we already know that the fauna of SE Asia is very rich (Massoud 1967, Yosii 1977). Although Lindroth (1979) concluded that the Aleutian Islands were not important for the dispersal of northern carabids, the populations of Neanurinae Collembola in these islands and the Pacific Alaska probably constitute important links in evolution of the E. Palaearctic and Nearctic faunas.

7. References

Addison, J.A. 1981. Biology of *Hypogastrura tullbergi* (Collembola) at a high arctic site. – Holarctic ecol. 4:49–58.

Allen, J.A. 1892. The geographic distribution of North American mammals. – Bull.Am.Mus.Nat.Hist. 4:199–241.

Axelson, W.M. 1900. Vorläufige Mitteilung über einige neuen Collembolen-Formen aus Finland. – Medd.Soc.Fauna Flora fenn. 26:105–123.

— 1902. Diagnosen neuer Collembolen aus Finland und angrenzenden Teilen des nordwestlichen Russlands. – Medd.Soc.Fauna Flora fenn. 28:101–111.

— 1903. Weitere Diagnosen über neue Collembolen-Formen aus Finland. – Acta Soc.Fauna Flora fenn. 28(2):1–22.

— 1903a. Beiträge zur Kenntnis der Collembolenfauna Sibiriens. – Öfv.Fin.Vet.-Soc.Förh. 45(20):1–13.

Bagnall, R.S. 1941. Notes on British Collembola. – Ent.mon.mag. 77:217–26.

Behan, V.M. 1978. Diversity, distribution and feeding habits of North American arctic soil Acari. – Ph.D. thesis, Dept.Ent., MacDonald Coll. McGill Univ., 428 pp. (unpubl.).

Bohnsack, K.K. 1968. Distribution and abundance of tundra arthropods in the vicinity of Pt. Barrow, Alaska. – Final Rep. Arctic Ins. N. Am. Project ONR-308 & ONR-321, 111 pp.

Bonet, F. 1945. Nuevos generos y especies de hipogastruridos de Mexico (Collembola) – Rev.Soc.Mex.hist.nat. 6:13–45.

Bourgeois, A. & Cassagnau, P. 1972. La différenciation du type Ceratophysellien chez les Collemboles Hypogastruridae – Nouv.Rev.ent. 2:217–226.

Bödvarsson, H. 1960. One new genus and three new species of Collembola from Alaska. – Opusc.ent. 25:43–51.

Börner, C. 1901. Über einen neues Achorutidengenus *Willemia*, sowie 4 weitere neue Collembolenformen derselben Familie. – Zool.Anz. 24:422–433.
— 1901a. Neue Collembolenformen und zur Nomenklatur der Collembola Lubbock. – Zool.Anz. 24:696–712.
Carpenter, G.H. 1900. Collembola from Franz Josef Land. – Sci.Proc.R. Dublin Soc. 9:271–278.
Cassagnau, P. 1958. Les espèces européennes du genre *Friesea* (Collemboles poduromorphes). – Bull.Soc.Hist.nat. Toulouse 93:17–29.
— 1972. Adaptation écologique et morphogenèse: Les écomorphoses. – Actes IX.Congr.Naz.Ital.Ent.: 227–244.
— 1979. Les Collemboles Neanuridae des Pays Dinaro-Balkaniques: Leur interêt phylogénétique et biogéographique. – Biol.Gallo-Hellenica 8:185–203.
— 1980. Nouveaux critères pour un redécoupage phylogénétique des Collemboles Neanurinae (s. Massoud 1967). – Proc.1.Intern.Symp. Aterygota Siena 1978:115–172.
Challet, G.L. & Bohnsack, K.K. 1968. Distribution and abundance of Collembola at Pt. Barrow, Alaska. – Pedobiologia 8:214–222.
Christiansen, K.A. 1951. Notes on Alaskan Collembola I. A new genus and species of the family Isotomidae – Psyche 58:24–31.
— 1951a. Notes on Alaskan Collembola II. Three new species of arctic Collembola. – Psyche 58:125–140.
— & Bellinger, P.F. 1974. Six new nearctic species of the genus *Friesea* (Collembola: Poduromorpha) – Pan-Pacific ent. 49:389–395.
— 1980. The Collembola of the North America North of the Rio Grande, I. Poduridae & Hypogastruridae. – Grinnell College, Grinnell. 386 pp.
Danks, H.V. 1979 (ed.). Canada and its insect fauna. – Mem.ent.soc.Can. 108:1–573.
— 1981. Arctic arthropods. A review of systematics and ecology with particular reference to the North American Fauna. – Ent.Soc. Canada, Ottawa. 608 pp.
Deharveng, L. 1979. Contribution à la connaissance des Collemboles Neanurinea de France et de la peninsule Ibérique. – Trav.Lab.Ecobiol.Arthrop.Edaph. Toulouse 1(4):1–61.
— 1981. La chaétotaxie dorsale de l'antenne et son interêt phylogénétique chez les collemboles Neanuridae. – Nouv.Rev.ent. 11:3–13.
— 1982. Contribution à la connaissance taxonomique et phylogénétique des Neanuridae I. Le genre *Rusekella* n.g. et ses implications phylogénétiques. – Bull.Soc.Hist.Nat. Toulouse 118:235–251.
Denis, J.R. 1947. Sur la faune française des Aptérygotes, XXV. – Bull.Sci. Bourgogne Suppl. 1:1–12.
Diece, L.R. 1943. The biotic provinces of North America. – Univ. Michigan Press, Ann Arbor.
Edwards, J.S. 1972. Soil invertebrates in North American arctic and alpine tundra. – Proc. 1972 Tundra Biome Symp. U.S. Tundra Biome Ecosyst.Anal.Stud.: 139–143.
Ellis, W. N. 1976. Autumn fauna of Collembola from central Crete. – Tijdschr.ent. 119:221–326.
Fabricius, O. 1780. Fauna groenlandica. – Rothe, Copenhagen. 452 pp.
Fjellberg, A. 1973. *Anurida frigida*. A new species of Collembola (Hypogastruridae) from Swedish Lappland. – Norsk ent.Tidsskr. 20:285–287.
— 1978. New species of the genus *Isotoma* from North America (Collembola, Isotomidae). – Ent.scand. 9:93–110.
— 1984a. Collembola from the Colorado Front Range. – Arct.alp.Res. 16:193–208.
— 1984b. Maxillary structures in Hypogastruridae (Collembola). – Ann.Soc.Roy.Zool. Belgique 114:89–99.
— 1984c. Elements of dorsal chaetotaxy in Neanuridae (Collembola) with descriptions of two new species of *Anurida*. – Ent. scand 15: 349–362.
Flint, R.F. 1971. Glacial and Quaternary Geology. – Wiley, New York. 892 pp.
Folsom, J.W. 1902. Papers of the Harriman Alaska Expedition. CCVII. Apterygota. – Proc.Wash.Acad.-Sci. 4:87–116.
— 1916. North American Collembolous insects of subfamilies Achorutinae, Neanurinae and Podurinae. – Proc.U.S.nat.Mus. 50:477–525.
— 1919. Collembola of the Canadian Arctic Expedition, 1913–1918. – Rep.Can.arct.Exp. 3:1–29.
Gama, M.M da. 1969. Notes taxonomiques et ligneés généalogiques de quarante deux espèces et sous-espèces du genre *Xenylla*. – Mem.est.Mus.Zool.Univ. Coimbra 308:1–61.
Gisin, H. 1949. Notes sur les collemboles avec description de quatorze espèces et d'un genre nouveaux. – Mitt.Schweiz.ent.Ges. 22:385–410.
— 1952. Notes sur les Collemboles avec démembrement des *Onychiurus armatus, ambulans* et *fimetarius* auctorum. – Mitt.Schweiz.ent.Ges. 25:1–22.
— 1960. Collembolenfauna Europas. Genève. 312 pp.
— 1963. Collemboles d'Europe V. – Rev. Suisse Zool. 70:77–101.
Hagemeier, E.M. 1966. A numerical analysis of the distributional patterns of North American mammals II. Re-evaluation of the provinces. – Syst.Zool. 15:279–293.
Hammer, M. 1953. Investigations on the microfauna of nothern Canada II. Collembola. – Acta arct. 6:1–108.
— 1954. Collemboles and oribatids from Peary Land (North Greenland). – Medd.Grönl. 127(5):4–28.
Holm, Å. 1973. On the spiders collected during the Swedish expeditions to Novaya Zemlya and Yenisey in 1875 and 1876. – Zool.scr. 2:71–116.
Holmquist, C. 1975. Lakes of northern Alaska and northwestern Canada and their invertebrate fauna. – Zool.Jahrb.Syst. 102: 333–484.
Hopkins, D.M. (ed.) 1967. The Bering land bridge. Stanford Univ. press.
Hopkins, D.M., Matthews, J.V., Wolfe, J.A. & Silberman, M.L. 1971. A Pliocene flora and insect fauna from the Bering Strait region. – Palaeogeog., Palaeoclimat., Palaeoecol. 9:211–231.
Hurd, P.D. & Lindquist, E.E. 1958. Analysis of soil invertebrate samples from Barrow, Alaska. – Final Rep.Arctic Inst.N.Am. Project ONR-173 & ONR-193. 24 pp.
Hüther, W. 1962. Beitrag zur Gattung *Willemia* Börner (Collembola). – Beitr.ent. 12:511–525.
Kevan, P. 1978. Anthophilous springtails (Collembola)

from the Alaska north slope, from Signy Island, Antarctica and from near Ottawa, Ontario. – Rev.Ecol.Biol.Sol. 15:373–378.
Leinaas, H.P. 1981a. Cyclomorphosis in the furca of the winter active Collembola *Hypogastrura socialis* (Uzel) – Ent.scand. 12:35–38.
— 1981b. Cyclomorphosis in *Hypogastrura lapponica* (Axelson, 1902)(= *H. frigida* (Axelson, 1905) syn.nov.) (Collembola, Poduridae). – Zeitschr.zool.Syst.Evol.-forsch. 19:278–285.
Lindroth, C.H. 1979. The importance of Beringia as reflected in the present fauna. *In* Erwin, T.L., Ball, G.E. & Whitehead, D.R. (eds.). Carabid beetles: Their evolution, natural history and classification. – Proc 1.Intern.Symp.Carabidology, Washington 1976:349–354. Junk, Boston. 635 pp.
Linnaeus, C. 1758. Systema naturae per regna tria naturae, secundum classes, ordines, genera, species cum characteribus, differentiis, synonymis, locis. 10 ed. – Holmiae. 824 pp.
MacLean, S.F. 1975. Ecological adaptations of tundra invertebrates. *In* Vernberg, J. (ed.). Proc. AIBS symp. on physiol.adapt. to the environment. Amhurst, Mass., pp. 269–300.
— Douce, G.K., Morgan, E.A. & Skeel, M.A. 1977. Community Organization in the soil invertebrates of Alaskan arctic tundra. – Ecol.- Bull. 25:90–101.
— Behan, V. & Fjellberg, A. 1978. Soil Acari and Collembola from Chaun Bay, northern Chukotka, USSR. – Arct.Alp.Res. 10:559–568.
Macnamara, C. 1922. Two new species of *Achorutes* (Collembola) – Canad.ent. 54:149–153.
Martynova, E.F. 1978. New species of springtails of the genus *Hypogastrura* s.l. in the north-eastern Asia fauna. *In:* Tsherepanov, A.I. (ed.). Taxonomy and ecology of Siberian arthropods. – Akademia Nauk USSR, Novosibirsk. pp. 27–47.
— & Bondarenko, E.P. 1978. New and little known species of springtails (Collembola) of the families Hypogastruridae and Isotomidae from Chukotka region. *In*: Tsherepanov A.I. (ed.). Taxonomy and ecology of Siberian arthropods. – Akademia Nauk USSR, Novosibirsk. pp. 48–58.
— ,Gorodkov, K.B. & Tshelnokov, V.G. 1973. Springtails (Collembola) from Wrangel Island. – Rev.ent.URSS. 52:76–93.
Mason, W.R.M. 1958. Distributional problems in Alaska. – Proc.10th.Int.Congr.Ent. (Montreal 1956) 1:703–710.
Massoud, Z. 1967. Monographie des Neanuridae. Collemboles poduropmorphes a pièces buccales modifées. – Biol.Amer.Austr.CNRS. 3:7–399.
Matthews, J.V. 1979. Tertiary and Quaternary environments: Historical background for and analysis of the Canadian insect fauna. *In*: Danks, H.V. (ed.). Canada and its insect fauna. – Mem.ent.soc.Can. 108:31–86.
McAtee, W.L. 1923. Apterygota. *In:* Prebele, E.A. & McAtee, W.L. (eds.). A biological survey of the Pribilof Islands, Alaska. – North Am. Fauna 46:139.
Merriam, C.H. 1892. The geographic distribution of life in North America with special reference to Mammalia. – Proc.biol.soc.Wash. 7:1–64.
Mills, H.B. 1932. New and rare North-American Collembola. – Iowa St.Coll.J.Sci. 6:263–276.
— 1934. A monograph of the Collembola of Iowa. – Collegiate Press, Ames. 143 pp.
Nicolet, H. 1842. Recherches pour servir à l'histoire des podurelles. – Neue Denkschr.allg.Schweiz.Ges.Naturwiss. 6(3):1–88.
Remmert, H. 1980. Arctic animal ecology. – Springer-Verlag. Berlin, Heidelberg, New York. 250 pp.
Rusek, J. 1973. Neue Collembolen von den Überschwemmungswiesen Süd-Mährens. – Věstník čs.spol.zool. 3:183–194.
Salmon, J.T. 1964. An index to the Collembola. – Bull.R.Soc.N.Zealand 7:1–651.
Schäffer, C. 1896. Die Collembolen der Umgebung von Hamburg und benachbarter Gebiete. – Mitt.naturh.Mus. Hamburg 13:147–216.
— 1900. Die arktischen und subarktischen Collembola. – Fauna arct. 1:235–258.
Schött, H. 1893. Systematik und Verbreitung Palaearktischer Collembola. – Kongl.Sv.Vet.-Akad.Handl. 2(11):1–100.
— 1902. Etudes sur les Collemboles du Nord. – Bih.Sv.Vet.Akad.Handl. 28, afd. 4(2):1–48.
— 1923. Collembola. – Rep.Sci.Res.Norw.Exp.Novaya Semlya 12:1–14.
Scott, H.G. 1962. Collembola from Oregon. – Ent. News 73:237–241.
Scudder, G.G.E. 1979. Present patterns in the fauna and flora of Canada. *In:* Danks, H.V. (ed.). Canada and its insect fauna. – Mem.ent.soc.Can. 108:87–179.
Stach, J. 1949. The apterygotan fauna of Poland in relation to the world-fauna of this group of insects. Families Neogastruridae and Brachystomellidae. – Acta Monogr.Mus.Hist.Nat Krakow. 341 pp.
— 1962. On the fauna of Collembola from Spitsbergen. – Acta zool. Cracov. 7:1–20.
Templeton, R. 1835. Description of the Irish species of Thysanura. – Trans.ent.soc.Lond. 1(2):89–98.
Thibaud, J.M. 1972. Révision du genre *Schaefferia* Absolon, 1900 (Insecte, Collembole). – Ann.speleol. 27:363–394.
Tullberg, T. 1871. Förteckning öfver svenska podurider. – Öfv.K.Vet.Akad.Förh. 28:143–155.
— 1876. Collembola borealia. Nordiska Collembola. – Öfv.K.Vet.Akad.Förh. 33:23–42.
Udvardy, M.D.F. 1963. Zoogeographical study of Pacific Alcidae. *In:* Gressitt, J.L. (ed.). Pacific basin biogeography. – Bishop Museum Press, Honolulu. pp. 85–111.
Valpas, A. 1967. Collemboles of Spitsbergen. – Ann.ent.Fenn. 33:28–40.
Wahlgren, E. 1900. Collembola während der schwedischen Grönlandexpedition 1899 auf Jan Mayen und Ost-Grönland eingesammelt. – Öfv.K.Vet.Akad.-Förh. 57:353–375.
Watson, D.G., Davis, J.J. & Hanson, W.C. 1966. Terrestrial invertebrates. *In:* Wilimovsky, N.J. & Wolfe, J.N. (eds.). Environment of the Cape Thompson Region, Alaska. – U.S. Atomic Energy Commission. Div.Techn.Inf., Springfield. pp. 565–584.
Yosii, R. 1960. Studies on the collembolan genus *Hypogastrura*. –Am.Midl.Nat. 64:257–281.
— 1961. Further remarks on the Collembola genus *Hypogastrura* with description of a new genus. – Am.Midl.Nat. 66:250–251.
— 1962. Studies on the Collembolan genus *Hypogastru-*

ra II. Nearctic forms collected by Prof. F. Bonet. – Contr.biol.Lab.Kyoto Univ. 13:1–25.
— 1969. Collembola-Arthropleona of the IBP-station in the Shiga Heights, central Japan I. – Bull.natn.Sci.Mus. Tokyo 12:531–556.
— 1972. Collembola from the alpine region of Mt. Poroshiri in the Hidaha Mountains, Hokkaido. – Mem.natn.Sci.Mus. Tokyo 5:75–99.
— 1977. Critical check of the Japanese species of Collembola. – Contr.biol.Lab. Kyoto Univ. 25:141–170.

8. Index to systematic part

Synonyms in italics

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